REPORT RESUMES

ED 003 749 64
TEACHING MACHINES AND PROGRAMED LEARNING, 1962--A SURVEY OF THE INDUSTRY.
BY- FINN, JAMES D. AND OTHERS
NATIONAL EDUCATION ASSN., WASHINGTON, D.C.
REPORT NUMBER NDEA-VIIB-069-B-3 PUB DATE 62
CONTRACT OEC-SAE-9073
EDRS PRICE MF-$0.18 HC-$3.92 98P. NATL. ED. ASSN., TECH. DEV. PROJ. OCCASIONAL PAPER NO. 3

DESCRIPTORS- *PROGRAMED INSTRUCTION, *TEACHING MACHINES, *EDUCATIONAL EQUIPMENT, QUESTIONNAIRES, INDEXES (LOCATORS), *AUDIOVISUAL AIDS, DISTRICT OF COLUMBIA

THE PURPOSE OF THIS STUDY WAS TO (1) LOCATE COMPANIES AND ORGANIZATIONS IN THE UNITED STATES PREPARING PROGRAMS AND MANUFACTURING TEACHING MACHINES FOR COMMERCIAL DISTRIBUTION, (2) OBTAIN ACCURATE DESCRIPTIONS INSOFAR AS POSSIBLE OF THE TYPES, VARIETY, AND CAPABILITIES OF EQUIPMENT BEING MANUFACTURED AND THE TYPE AND CONTENT OF PROGRAMS BEING PREPARED, (3) ASCERTAIN SHORT-TERM TRENDS IN PLANS, DESIGN, AND DEVELOPMENT FOR EQUIPMENT AND MATERIALS, AND (4) ANALYZE THESE DATA FOR COMPARATIVE INFORMATION. A LITERATURE SEARCH WAS PERFORMED AND A QUESTIONNAIRE WAS DISTRIBUTED TO OBTAIN THE DATA FOR THIS SURVEY. LISTINGS OF AVAILABLE PROGRAMS, TEACHING MACHINES, AND EQUIPMENT SUPPLIERS FOR PROGRAMS AND INSTRUCTIONAL DEVICES WERE INCLUDED. (LP)

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Occasional Paper No. 3

TEACHING MACHINES AND PROGRAMED LEARNING, 1962: A SURVEY OF THE INDUSTRY

by

James D. Finn and Donald G. Perrin

A Report Prepared for the

TECHNOLOGICAL DEVELOPMENT PROJECT

of the

NATIONAL EDUCATION ASSOCIATION OF THE UNITED STATES

The Technological Development Project of the NEA was created under Contract #SAE-9073 with the United States Office of Education, Department of Health, Education and Welfare.

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ED003749

PUBLICATION NOTE

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PROLOGUE

A Voice from History

We should like to take this opportunity to introduce to all of those interested in the field of instructional technology, particularly the experimental psychologists and those associated with them in the development of teaching machines and programed learning, the following quotation. The exact reference to the quotation is as follows:

> Thorndike, Edward L., Education, New York: The Macmillan Company, 1912, pp. 164-167.

No comment is needed. Here are the insights of a genius. History can very often teach us a lesson in humility--and it does here. The interesting question is: why couldn't we see it then?

"Guidance in habit-formation and reasoning. Text-books often state what habits are to be formed without giving the reader exercises in forming them, but this is not a necessary feature of printed matter. Text-books on geography, history, spelling, English composition, grammar, economics, philosophy or sociology could, by the exercise of enough ingenuity, provide for the actual formation of habits in the way that books of examples to be done in arithmetic, or sentences to be translated in Latin, or experiments to be done in chemistry do.

"Text-books still less often guide the pupil to think out conclusions himself so far as he can. They commonly give the results of reasoning and perhaps problems demanding reasoning, but they do not so manage the latter that the pupil is at each stage helped just enough to lead him to help himself as much as is economically possible. They do not, that is, usually get the full value of the questioning, 'developing,' inductive, and experimental methods of teaching. Nor do they usually give work in deductive thinking so arranged as to stimulate the pupil to make and test inferences himself.

"This fact is partly due to conventional customs. But there is also a real difficulty, due to the fact that pupils cannot be trusted to follow directions. Books could be written giving data, directions for experiments and problems with the data, and questions about the inferences. The student could be instructed to read each helping piece of information, suggestive question and the like only after he had spent a certain time in trying to do for himself what he was directed to do. Such books might be more effective than all but the best tenth of personal teaching, if students would faithfully try as directed before reading ahead for the helps given.

But they will usually greedily use up all the helps first. If, by a miracle of mechanical ingenuity, a book could be so arranged that only to him who had done what was directed on page one would page two become visible, and so on, much that now requires personal instruction could be managed by print. Books to be given out in loose sheets, a page or so at a time, and books arranged so that the student only suffers if he misuses them, should be worked out in many subjects. Even under the limitation of the natural tendency of children to get results in the easiest way, a text-book can do much more than be on the one hand a mere statement of the results of reasoning such as an ordinary geography or German grammar is, or on the other hand a mere statement of problems, such as the ordinary arithmetic or German reader is.

"From the point of view of interest in work, personal teaching is usually more sociable, but the difference between it and text-book teaching in this particular could be reduced by skill in organizing the latter.

"The evils of rote-memorizing or merely absorptive study on the part of pupils, and of lack of progress on the part of teachers, which are attributed to text-books, are not at all necessary consequences of their use. It is easy to make it more satisfying to pupils to understand than to memorize, and to think than merely to read. A lazy or stupid teacher will not be cured so well by being deprived of all text-book aids in teaching a subject as by being given a dozen such and required to show that he uses them all well.

"The misuse of text-books. Finally, many of the evils attributed to the overuse of text-books are really due to misunderstanding and misuse of them. In the case of a good text-book there is a reason for every item and for its position in the whole. Too few teachers know the exact purpose of the text-books they use. Too often a teacher uses a section of a book much as a savage might use a coat to cover his legs; or as a child uses a saw to cut a string, scissors to cut a board, and a padlock as a bracelet.

"On the whole, the improvement of printed directions, statements of facts, exercise books and the like is as important as the improvement of the powers of teachers themselves to diagnose the condition of pupils and to guide their activities by personal means. Great economies are possible by printed aids, and personal comment and question should be saved to do what only it can do. A human being should not be wasted in doing what forty sheets of paper or two phonographs can do. Just because personal teaching is precious and can do what books and apparatus can not, it should be saved for its peculiar work. The best teacher uses books and appliances as well as his own insight, sympathy, and magnetism."

FOREWORD

In attempting to assess the impact of the potential revolution in the technology of instruction upon American education as a whole and the educational profession in particular, the Technological Development Project has, wherever possible, drawn its information from existing studies, surveys and experiments and by direct observation and interviews. We view our task essentially as one of synthesis; to make some kind of sense out of the mounting knowledge, speculation and developments in the field of instructional technology; to forecast what reasonably might be expected to occur in the next few years and to set up some guidelines for the profession to use in dealing with the accelerating changes of the future.

Unfortunately, from the standpoint of efficiently getting on with the task, hard-core information is not always as available as might be expected. Two directly related areas at present suffer from this defect. These are (1) trends and developments in the newer materials of instruction (newer media) and (2) trends and developments in the hardware or devices used with the newer media. There is much--too much--scattered information, to be sure, but this information does not exist in one place and much of it is inaccurate.

Because of this situation, a decision was reluctantly made to make two related trend and development surveys--one on materials, the other on devices. The results of these two studies will be published later by the Project as monographs.

The present occasional paper is an outgrowth of these two larger surveys. Because programed learning and teaching machines have evoked so much interest and effort among the educational, military and industrial sectors since 1958, available information concerning developments changes almost daily. At the same time, questions as to the status of these developments from all sources multiply daily. Further, several national groups and many individual research workers have an immediate need for this information.

In the design of both the materials and hardware surveys, it was decided to place a special emphasis upon the programed learning--teaching machines area for reasons of great national interest and the existing lack of accurate information. In designing this special sub-survey, the Project had the advice and counsel of Professor Arthur Lumsdaine of the

University of California at Los Angeles, a member of the Advisory Committee of the Technological Development Project.

Professor Lumsdaine, sensing the same lack of information, had begun designing a survey of his own with some thought of bringing the idea before the joint committees of the American Educational Research Association, the American Psychological Association and the Department of Audio-Visual Instruction of the NEA that are working on standards in the programing and machine fields. When Professor Lumsdaine discovered the Project also had such a survey in mind, he suggested that the Project take over the task and kindly turned over all his materials to us.

The decision to publish the basic information derived from the special programed learning--teaching machines survey as an occasional paper with relatively limited distribution is based on several considerations. First, the information is dated because of the rapid changes taking place in these two fields. Second, the groups desiring it expressed a need for it now. Third, and most important, one of the declared purposes of the project as set up with the U.S. Office of Education is to disseminate information concerning technological developments to the field as rapidly as possible. We should like to emphasize, however, that this is a sounding of a channel whose sands are shifting constantly and should be so treated by the reader.

James D. Finn
Los Angeles
January, 1962

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TEACHING MACHINES AND PROGRAMED LEARNING, 1962:
A SURVEY OF THE INDUSTRY

SECTION I

OVERVIEW OF THE STUDY

The ultimate questions that educators and parents must ask about programed learning and the devices used to manipulate the programs (teaching machines) can only be answered in the classrooms of the nation. These are questions such as: Can all kinds of students learn more and better from programed materials? What kinds of subject matter can best be learned this way? Does the system work over a long period of time? What happens to motivation when dealing with programed materials in the long pull? There are many more.

The time has been too short to provide ultimate answers to ultimate questions concerning teaching machines and programed learning. The current interest and effort in this field cannot be dated much before 1958, even though S. L. Pressey was pioneering with a form of teaching machine in his laboratory at Ohio State University in the 1920's, and many psychologists date the newer movement from the time of a well-known article by B. F. Skinner that appeared in 1954 (28). In this short space of time, the development of the movement has been phenomenal; research efforts, first in the laboratory and now increasingly in the field, have grown apace; interest among the educational profession, industry, and the public continues to mount.

The returns from all of this effort, interest and research are just beginning to come in. Dr. Harry Silberman, of the Systems Development Corporation, has made a thorough analysis, for example, of the existing research studies. He has found about 100 in all, only 10 per cent of which have been published to date in journal form. Dr. Silberman has made an insightful criticism of this body of research, pointing out, for example, the lack of sufficient numbers of cases in many studies, the shortness of time of many of the experiments, and the short programs used. He has been the leader in calling attention to the need for extensive field testing.[1]

---

[1] Dr. Silberman is preparing a paper on this subject. He has referred to it in several speeches and in private conversations with one of the authors of this paper.

Field testing is going on here and there in the country. The Center for Programed Instruction of New York City has several such tests underway, as has Encyclopaedia Britannica Films and the Institute for Communication Research of Stanford University. The research side of the state of the art of teaching machines and programed learning is, however, in flux. It will be some time before the ultimate questions are answered.

Notwithstanding, it should be pointed out to the uninitiated reader that a body of information concerning the teaching--learning potential of programed learning does exist. Reference should be made to the bible of the movement--Lumsdaine and Glaser (16)--and the excellent new book by Stolurow (29). Enough has been uncovered to convince many hard headed educators that programed learning and the accompanying devices have a great--some say a revolutionary--potential for education.

With this as background, it is time to state that the study discussed in this paper does not deal with ultimate questions. Our objective is much more modest. There are, in the analysis of any phenomenon, questions which are not ultimate, but which are still important and for which people would like to have answers. Edgar Dale, in perhaps his greatest essay, has the professor, Maxim Kleeshay, say to the young student, Harrison,

> In education, nothing is ever "secondary," except the last four years of high school. Our objectives are all primary.

And a little later, Harrison asks,

> Who does the "secondary" tasks or works on the "secondary" objectives? (6:3)

In a sense, the study reported here deals with secondary problems related to the field of teaching machines and programed learning. We hold that these are important problems and attention to them is needed now.

Essentially, this paper reports the results of a measure of the development of the commercial field of teaching machines and programed learning made from readings taken during the last half of 1961. By "commercial field" we mean what may be loosely described as the teaching machines and programed learning industry. While most of the work in this area began in the universities and other research institutions and much of it remains there, to become effective in schools and colleges in the American system, development and production has to move from the research institution into commercial channels. Schools and colleges must not only be able to buy and obtain delivery on machines and programs in order to use them, but they must have a choice among programs, systems of programs and devices.

Since such programs and devices, due to educational, industrial and military interest, have a potential market value, it was inevitable that their development, manufacture, exploitation and marketing should attract sectors of American industry having such capabilities. This has resulted, in a relatively short period of time, in the limited availability on the open commercial market of a variety of types of equipment and programs. As to equipment, there are many more models now on the drawing board, in prototype form and under test. The same thing is true of programs. Publishing firms and other organizations are writing and testing programs in some quantity, and many of these have not yet reached the field.

This situation, because it has moved with great rapidity, provides the impetus for this survey. The question, heard on all sides from research workers, curriculum supervisors, school administrators and industry itself is, essentially, "what is going on in the teaching machines--programed learning industry?" A further question is, "what is to be expected in the near future?" These are questions we have tried to answer.

SECTION II

METHODOLOGY

It is probably presumptive to use the term "methodology" in connection with a report of this study, particularly in view of the severe empirical orientation of many of our readers. However, means were developed to obtain the information and these means will be reported in this section as the method of this study.

Purpose

It was the purpose of this study to: (1) locate as many as possible of the companies and organizations in the United States preparing programs and manufacturing teaching machines for commercial distribution, (2) obtain accurate descriptions insofar as possible of the types, variety and capabilities of equipment being manufactured and the type and content of programs being prepared, (3) ascertain short-term trends in plans, design and development for both equipment and materials, and (4) analyze these data for comparative information.

Method

As a first step, all literature pertaining to the problem was reviewed. In the beginning, this review was not done in the classical sense of laying the background for a further study, but to obtain information of use in aiding the achievement of the general objectives of the Technological Development Project. As indicated in the foreword, it was not until it became apparent that the existing literature could not supply satisfactory information, that the decision was made to pull together detailed, first-hand information concerning the teaching machines--programed learning field as part of a larger study of instructional hardware. A brief discussion of this literature will follow later on in this section.

The survey itself was accomplished in three general steps, (1) locating companies, (2) obtaining the data, (3) validating the data. The names of the companies were obtained from many different sources by many different means. The following were the most important:

1. Published literature, including audio-visual, psychological and other periodicals.
2. Unpublished research reports.

3. Advertising brochures.
4. Attendance at conferences and conventions.
5. Files in the office of the Department of Audio-Visual Instruction of the NEA.
6. Files of certain individuals and groups, particularly those of Professor A. Lumsdaine of UCLA and the Rheem-Califone Corporation of Los Angeles.
7. Personal contact with manufacturers, users and research workers.
8. Correspondence with knowledgeable individuals.

While this process seems simple, actually it was not. The field is changing so rapidly that companies may be in and out of business or absorbed into larger units almost daily. As an example, during one stage of writing this report, one large company dissolved a division devoted to teaching machines and programing while negotiating for the purchase of the rights to distribute other equipment manufactured by another company. In the last three months, there has been a noticeable growth in small companies devoted to programing.

Due to the flux of the situation, a last-minute effort was made to validate the list. This was done by checking the list with two important information sources, the Center for Programed Instruction of New York City and the United States Air Force. P. Kenneth Komoski and his staff at the Center were most helpful in checking our list; Dr. Joseph Tucker of Wilmington, Delaware, recommended that our list be checked with one maintained by the Air Force; this checking was done by the Washington office of the Project with the Special Training Devices Division.

Every effort, therefore, was made to make the lists as presented in Sections V, VI and VII as complete and accurate as possible. Questionable reports in the literature were double-checked by contact either with the companies cited or with knowledgeable individuals. Many telephone calls were made at the last minute in order that the published lists might be as accurate and up-to-date as possible. Since the field is in such a state of flux, however, the reader should be cautioned that this type of specific information is dated and should be so treated.

The second step was to obtain the data. A questionnaire was prepared asking for detailed information about machines and programs. No definition was given as to what should be regarded as a "teaching machine," and the form was entitled "Survey of Teaching Machines and Related Developments" to encourage as wide a response as possible. The final format was a hybrid of questionnaires prepared separately by Dr. A. A. Lumsdaine and the Technological Development Project.

As indicated above, the special programed learning--teaching machines survey was conducted in conjunction with a more general survey of instructional hardware conducted by letter, personal visits, etc. The questionnaire was inserted, first, in the letters going out on the larger survey to those companies to which it applied. As additional names were obtained, questionnaires and accompanying letters were sent directly.

A maximum effort was made to insure a high percentage of response. Second and third letters were sent; personal contacts were made with company representatives and, at the end, the telephone and telegraph were used to attempt to bring in late respondents. During this period, a check was continually made on the status of the field so that inquiries were directed to new names as soon as they were uncovered.

The coverage of the questionnaire is presented in Table I. We are pleased that the response, for this type of survey, is exceptionally high. The response is, in fact, over 90 per cent. If the negative replies and bad addresses are deleted, the response is nearly 100 per cent. One caution should be applied in interpreting these figures. There are, no doubt, a few companies and organizations that did not find their way to our list. There is no way of telling exactly how many such omissions there might be. We have reason to believe that the figure would be very small.

TABLE I

RESPONSE TO QUESTIONNAIRES

	No.	Per cent
Number of questionnaires sent out: 181		
Number of replies	165	91.2
No reply	16	8.8
	181	100.0
Of the 165 replies (100%), the following breakdown of responses occurred:		
Included in report	104	63.0
Negative	25	15.2
Did not meet criteria	20	12.1
Not ready to publicize	9	5.5
For research purposes only	7	4.2
	165	100.0

The questionnaire used was a highly condensed document of only two pages, a copy of which is presented as Appendix A. Originally, it was intended as an exploratory tool only and, as such, suffers from its brevity and leaves something to be desired in clarity. The problem of clarity is compounded by the lack of common definition, not only in the teaching machines--programed learning field, but in the whole field of instructional technology.[2]

Recognizing the weaknesses in the questionnaire, validation was accomplished after the fact, so to speak. Photographs, research reports and descriptive material were requested from each company and organization, and data derived from these sources was used to fill out and clarify information on the returns. In case of questions which could not be resolved in this way, the company was contacted directly and the correct information ascertained. Thus, the questionnaire was used as a core instrument and supplemented with other means of gathering information.

Nothing formal will be stated concerning the limitations of such a study as this. Some limitations, particularly those dealing with questions as to what is and what is not a teaching machine, will be discussed in the text. The limitations of the questionnaire have been noted as well as the means used to overcome these limitations.

A Note on the Literature

The growing literature of programed learning and auto-instructional devices contains two sections directly related to the purposes of this study. These are: (1) categorization and classification, and (2) lists of machines, manufacturers, programs and programers. Four particularly valuable attempts at categorization are those of Porter (21), Stolurow (29), and Silvern (26), (27) for devices, and Rigney and Fry (22) for programs. A thorough analysis of these was made before developing the categories and classifications used in this study.

Directly related to the purposes of this study are several efforts to provide lists of devices and programs. All such existing lists known to the authors were reviewed, as indicated above, in the hope that this survey would not have to be undertaken. Unfortunately, all existing lists (including the accompanying information concerning manufacturers, devices, etc.) proved to be out-dated, incomplete, inaccurate, or a little of all three. The major problem in compiling all of this previous information was the rapid shifting of the teaching machines--programed learning field. It has been very difficult to take a reading.

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[2] The Technological Development Project has a special Commission working on the problem of definition and terminology under the direction of Professor Donald Ely of Syracuse University.

Lists of devices and manufacturers have been composed by Lumsdaine (17), Fry, Bryan and Rigney (11), Ross (23), Sturwold (30), Foltz (9), Stolurow (29), and Leavitt (15).

Excluding Lumsdaine, who is primarily descriptive, Fry, Bryan and Rigney's work is perhaps the earliest list--certainly the earliest which was published. As such, it suffers somewhat from the rapid changes which took place during and immediately after publication. The authors were aware of this and cautioned the reader in an epilogue. Further, due to the design of their study, Fry, Bryan and Rigney made no particular effort to separate the commercial from the built-for-research-only machines. For its time, it was a benchmark.

Ross and his group must have been working in the same area during the time Fry, Bryan and Rigney completed their study. Unfortunately, Ross used a relatively naive approach, concentrating on a few industries and relying somewhat on information circulating in financial circles. His list--probably the first source of Komoski's often repeated statement about "one hundred companies making or designing teaching machines"--actually is a conglomeration of companies, research workers and institutions.[3]

Sturwold's list was exceptionally accurate and reasonably comprehensive for a list compiled as a service by a monthly magazine. Her problem was the same as that of Fry, Bryan and Rigney--the ephemeral nature of the information at that particular time. On the other hand, Foltz, writing later, had the advantage of a little more stability in the industry. Unfortunately, for causes not readily apparent, Foltz's list contains a number of inaccuracies--a condition he tried to remedy with a mimeographed supplement.

The Leavitt list follows the pattern of many other lists in that both experimental and commercial devices are included. This particular list, too, is somewhat truncated in comparison with others.

The final list in the previous literature appears in Stolurow's book. As mentioned before, the whole study is an excellent piece of work and Stolurow's list is no exception. However, Stolurow was, like Fry, Bryan and Rigney, under no particular compulsion to separate out and study the industrial--commercial phenomenon of the teaching machines--

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[3] See, for example, the editorial page of the New York Times of October 21, 1961 for the Komoski quotation. Komoski's figures are, as this survey shows, not too far off the mark.

programed learning movement. As a result, research and developmental machines and programs are intermixed with the commercial strains.

An analysis of the literature reveals, then, that outside of the attempt by Ross, there does not exist a study of the teaching machines--programed learning industry as such.

The literature on sources of programs is not quite as extensive as that on devices. Five important references were noted: Fry (10), Rigney and Fry (22), Foltz (9), Charry (5), and Leavitt (15). Fry made a preliminary report on the work that he and Rigney were doing in their study of programing trends in the spring of 1961. This was followed by the excellent overall report appearing as a special supplement to the Audio-Visual Communication Review. In their preface, the authors note,

> Because of the rapid expansion of the programed learning field, an exhaustive sample is out of date by the time it can be published. (22:6)

The Rigney and Fry list of eighty-one programs is all-inclusive as of the end of 1960. That is, it includes research-type programs as well as commercially available programs. Great changes have occurred since this publication.

The comments applied to Foltz's analysis of devices and manufacturers also apply to his treatment of programs. The same is true of Leavitt. This leaves the last reference--a continuing register of programs maintained by Professor Harvey Stackman (edited by Charry) of Temple University. Again, we found that the Stackman register was, at this point in time, not as complete as our searching indicated it should be. This is, no doubt, due to the delay in time before programers list their programs in the register. In due time, the Stackman register should be a valuable source of information.

This brief analysis indicates why the authors felt that the existing literature fell short of the needs of the Technological Development Project for current and accurate information as to the status and prospects of the teaching machines--programed learning industry. This we set out to remedy with the survey and methods described at the beginning of this section.

SECTION III

MACHINES AND PROGRAMS: SOME DEFINITIONS AND A CONCEPTUAL STRUCTURE

Even a normative survey, if it is to have value, must have a conceptual structure. Superficially, it would appear that the conceptual structure involved in surveying the teaching machines--programed learning industry would be so slight that it should not even be dignified by the term, "conceptual structure." This, however, is a naive view that will suddenly run into difficulty in trying to answer one question: "what, exactly, is a teaching machine?" And there are several other such questions.

Below the surface, all is not completely smooth in the area of auto-instruction. There is a certain amount of acrimony to be expected, we suppose, in all debates between psychologists. In the field under consideration, this controversy is somewhat more extensive than the usual run-of-the-mine arguments over theoretical positions. There are, to begin with, commercial aspects to these arguments, as the potential for commercial exploitation of these developments arises. In addition, the novelty of the field and the rather spectacular results of early work have developed disciples who, like all disciples, are out to convert the multitude. Finally, into the reaches of professional education itself have come controversial questions of a social nature that cannot be ignored such as, "will the machine replace the teacher?"

It would seem that in a survey such as this, academic controversy does not need to be considered. It is true that some of the social questions, for example, can be reserved for treatment elsewhere in other publications of the Project. However, at least two large questions are at the very base of this report. One is the question of what, if any, role is there for machine technology in programed learning. The other is what is and what is not a teaching machine. Some related questions have to do with programs.

Machine Versus No Machine

The concept of the program without the machine is implicit in Shakespeare's line, "The play's the thing." In other words, the machine exists merely to manipulate the program and it is the program that does the teaching; it is the program from which the student learns; it is the program which is the creative aspect of the process and the child of the psychologist-subject matter-programer.

The emphasis upon the program has a great deal of appeal educationally, socially and, to a certain group of companies, commercially. It has been one of the earmarks of the philosophy of the Center for Programed Instruction of New York City and its president, P. Kenneth Komoski. Komoski has been widely quoted in the press warning educators not to become enamored with machines at the present state of the art and, in fact, to be very wary of buying machines at all when programs can be presented in notebooks, books, etc. On the commercial side, Maurice Mitchell, president of Encyclopedia Britannica Films, has been quite vigorous in his opposition to a machine emphasis.

Komoski has suffered from truncated quotation in the press. His position with respect to the machines--program problem takes more explaining than newspaper columns allow. He feels that the present state of the art could produce much more sophisticated machines within the reach of school budgets and that there is little sense in going through all the stages of development from the Model T to the present automobile when the present automobile could be built now. Many of the simpler machines are of the Model T type--little better than a simulated machine (programed book). Komoski, therefore, cannot be described as "anti-machine," although such are the vagaries of this business that he has, in some quarters, acquired that reputation.[4]

Existing machines have been referred to as "mechanical page turners," and by other names which imply that they are superficial, useless and mere gadgets. This attitude has been picked up within professional educational circles, especially by those professionals dealing with curriculum, and gadgetry is castigated on all sides.

At a more profound level, Lewis Eigen, also of the Center for Programed Instruction, has set up a machine--non-machine dualism in an excellent paper he delivered before the American Psychological Association (8). Eigen defines a "machine technology," by which he means the equipment, systems and organization necessary to the use of conventional audio-visual devices and materials such as the sound motion picture. Opposite to this machine technology, as the second half of a dualism, he sets a "behavioral technology" by which he apparently means the applied psychological know-how derived from learning experiments on animals and humans. This know-how is, of course, manifested in its pristine form in programed learning. The balance of Eigen's paper makes some useful suggestions as to the strategy necessary for introducing this new behavioral technology into the school system.

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[4] This information was developed by several conversations held between the senior author and P. Kenneth Komoski, President of the Center for Programmed Instruction of New York City.

The Eigen dualism, on its behavioral side, is merely a restatement of the concept that educational methodology should be based on experimental psychology. This point of view was perhaps best stated somewhat earlier by Melton (19). Melton, however, was not advocating a dualism, but was calling for a return to the relationship between education and psychology that once held at the time of Thorndike, Judd, Charters, Bobbitt, and others. This view is returning to favor among psychologists and educators. Eigen, on the other hand, apparently views behavioral technology as the antithesis of machine technology.

Philosophically and practically, we cannot accept this machine technology--behavioral technology dualism. We hold that machine functions are just as much a part of the developing instructional technology as are the functions of behavioral analysis and operant conditioning. In our view, the dualism is false to begin with, as is the artificial (and emotional) casting out of the machine as a tin page-turner. Nor can the present state of the art be used as an excuse permanently to discard the machine. Technological art, these days, is often shorter than time. The machine today is not the machine tomorrow.

On the other hand, the charge of gadgetry *can* be leveled at those who consider the machine *sing an dich* without reference to the content of whatever it carries, the uses to which it may be put and the humans to which it relates. The machine, in isolation from content, use and people, is frozen as the other half of this dualism.

The dualistic position of machine--non-machine is unacceptable principally because it does not fit the known facts of a technological system. Machines exist in a system in order to do something. The material on which they work has something done to it. Without the material, the machine is useless; without the machine the material remains useless. Together, machine and material make a unity. This unity is related to people both before and after operation, and becomes, therefore, a still larger unity. Without the human factor, the machine-material unit has no meaning.

For example, the housewife is never so naive as to think of her automatic washing machine without reference to its object--the cleaning of clothes--and the manner in which it operates. She does not think of her dirty clothes without reference to what the machine can do for them and in what manner it must be done. A transaction exists here--a field--in which any change changes the entire field--and the housewife knows this instinctively. Some educators, it seems, exhibit a naivete toward instructional technology not shown around the American home.

The technology of behavior--psycho-technology--, contrary to Mr. Eigen, has had an intimate relationship with the audio-visual movement since 1919 when Lashley and Watson undertook to determine the effects of certain films dealing with venereal disease. Similarly, the machine technology (to use Eigen's term) continues (in 1962) to relate to behavioral technology in the programed learning field.

The question here is really one of perspective. What exists in an admittedly imperfect form is a man-machine system related to other systems and consisting of at least these elements, stated in a highly oversimplified manner:

1. student(s)
2. a classroom or other school environment
3. a subject matter
4. a programer or programers with a theory about
   a. the subject matter
   b. the nature of learning and of students
   c. programing
   d. educational objectives
5. a system of programing
6. a program
7. a machine
8. a medium for the program in the machine
9. teacher(s) who have theories (not necessarily the same) about the same matters as do the programers.

Obviously, the relations of each of these elements to each other and to other outside systems varies as does the complexity of the elements themselves. The classroom, for example, is a sub-system of a larger system which includes the school, the logistical support of instruction, etc.

The point is, however, that this system of teaching machines and programed learning, imperfect as it may be and imperfectly described as it probably has been, cannot be treated as a dualism of machine on the one hand and behavioral technology on the other. A change in any one of these elements will cause changes in all of the others. For example, in Eigen's frame of reference, if one theory of behavioral technology were replaced by another (a linear programer were replaced by a branching programer) the entire system would be changed.

Similarly, the machine used and the medium used in the machine both have a great effect on the system. The degree of sophistication of the machine will determine the nature of the program and of the medium just as much as the theory of the programer. Similarly, the medium used will profoundly alter the nature of the teaching and learning taking place and the machine requirements. For example, the use of 8 mm sound motion pictures in a teaching machine (a step not yet taken) could move the entire teaching-learning process away from Skinnerian verbal behavior models very quickly.

To summarize this position, we say that the teaching machine as a machine is a part of the system and cannot be dismissed as either mere gadgetry on the one hand or as something apart and unaffected by and not affecting behavioral technology on the other. As Tucker noted in connection with weapons systems,

> A weapon system is one when all its parts are working. A fighter plane with a poorly trained pilot is not a weapon system. A poorly maintained fighter plane is not a weapon system, either. (31:56)

Melton generalized this point of view very well, and our argument can be closed with his words:

> I believe that the only scientific answer to the many questions raised about the goals of training and training media, and the criteria in terms of which their learning products may be evaluated, must be in the terms of reference of the total system of which the modifiable and modified human components are a part. (20:203)

We hold that the growth and development of machines is a legitimate concern of an overall approach to instructional technology provided the role of the machine in a man-machine system is understood.

What is a Teaching Machine?

Many educators feel that the term, "teaching machine," is an unfortunate expression for many reasons. Lumsdaine and Klaus noted that such terms as "teaching machine" are "misleading, prejudicial, or both." (18:208) Among some practicing professional educators, phenomenological psychologists, etc., the word "machine" implies a form of mechanization of human function which is unacceptable. The Council for Basic Education, representing a rather narrow liberal arts point of view in American education and, by definition, opposed to these same professional educators, appears to also have a general anti-machine orientation (12). Reaction to "machine" as a word shows up in many quarters.

Due to these feelings and for technical reasons as well, several alternative terms have been suggested. In some of his earlier work, Lumsdaine referred to "self-instructional devices " (17). Later, he and Klaus presented to the field the proposal that this class of instruments be called "auto-instructional devices " (18). Komoski and his group attempt to minimize the teaching machines problem and, instead, refer constantly to "programed instruction " (14).

The Advisory Committee of the Technological Development Project, in considering this study and in considering the general problem of definition in the field of instructional technology, has stated that the term, teaching machine, is unfortunate; that it should be replaced by a term such as that suggested by Lumsdaine and Klaus, and that emphasis should be directed toward programing.

The fact remains that the term, teaching machine, is short and succinct and, particularly in the popular press, interesting, provocative and exciting. Whether B. F. Skinner invented the term or not, he certainly gave it prominence and currency. So far has this term ranged, it is a moot point, we feel, whether it can ever be expunged from the vocabulary of psychologist, educator and reporter. Since it is in current use, misleading and prejudicial though it may be, we must, of necessity, use it in this study.

Teaching machine (auto-instructional device or self-instructional device) is, however, only a name. In order to collect, sort and categorize these machines, it is necessary to define and describe them. The problem is not as easy as it sounds. In fact, it is not even easy to define the word "machine." Any logician can tear the dictionary definition to pieces. As Michael Scriven so beautifully points out,

> There are many important terms in our language which cannot be explicitly defined for various reasons, yet can be correctly applied in typical cases. One of these is "machine," another is "science," and there are others such as "truth" and "toothache." We can readily apply such terms in some cases while in other cases it is hard to decide whether they apply, and there are likely to arise new cases of both sorts . . . a spontaneously-generated adding machine, complete even to the Marchant label, would present a problem that might leave the physicist and the theologian at a loss for words but not the comptometer operator, who would not hesitate to call it a machine . . . (after indicating his own definition) I think we can safely say that this would be a machine, without having to commit ourselves to any dubious propositions about what would not be a machine. (25:118-119)

In setting up the categories for reporting this survey, we faced the same types of problems. Is a Hughes Videosonic production prompter (performance aid) a teaching machine? Is a Temac notebook? Komoski defines a teaching machine as any device that can present a program. This, however, only raises further questions, such as, what is a program in this context? For, as everyone knows, each unit of the PTA converts itself into such a device once a month during the school year.

The answer to this general problem must, in order to sort out the real world of devices, be arbitrary. Reference to other attempts is, of course, useful as a start. The classification of mechanical teaching devices and/or materials other than books has been attempted many times. Adams (1910) (1), Hoban (1937) (13), and Dale (1946) (7) are all examples of the classification of devices and materials as they present information on an ascending scale from the concrete to the abstract. In cases where the response of the student was considered, the device was classified as "more concrete" than when overt passivity was involved; however, there were other dimensions to concreteness.

In 1957, Porter reclassified mechanical teaching aids and devices according to student behavior, taking into account the response element (21). He ended up with three categories, (1) stimulus devices, (2) response devices and (3) stimulus--response devices. Into the third category he put all devices now considered as teaching machines as well as simulators and pacers.

Recent work has included attempts to reclassify the whole system of devices of which Silvern's (1961) (26), (27) is the most sophisticated, and more intensive work in attempting to organize a conceptual structure into which the increasing variety of teaching machines could be placed. Both Stolurow (29) and Silvern have made contributions here.

In order to use any classification system, a definition fitting each category must be drawn and the device tested against the definition. There have been numerous attempts at defining self-instructional devices. We present the following:

1. Porter (21:119)

> Immediate reinforcers (teaching machine-type devices) are teaching devices which endeavor to alter the course of learning by automatically presenting the student with a "reward" or reinforcement immediately after he has made a correct response ... These devices all possess three operational characteristics: (a) they present a sequence of problem materials to the student; (b) they provide some means by which the student may record his solution to the problems: and (c) they automatically and immediately indicate correctness of the solution.

2. Foltz (9:30)

> A self-instructional device or "teaching machine" is any device which can present systematically programed materials while making efficient use of the principles of reinforcement. (Then follows a list of five technical elements such as a response panel.)

3. Stolurow (29:5)

> A teaching machine is defined here as a mechanism that presents information to a student and controls his behavior in a predetermined interacting relationship.

4. Lumsdaine and Klaus (18:209) (the definition here is by function)

> ... auto-instructional methods provide for the controlled presentation of material, the elicitation of appropriate responses, guidance with respect to the critical aspects of the subject matter, and control of the way in which learning proceeds (through use of proper sequencing, related features which seem to be demonstrably important for effective learning).

Within the patterns of such definitions as these there have been at least two serious attempts to categorize auto-instructional devices (Stolurow and Silvern). Stolurow sets up three categories of teaching machines: (1) minimally adaptive, (2) partially adaptive, and (3) adaptive. Adaptivity is defined as the capacity of the machine and program to adjust to the needs of the learner (29:14-15). Silvern, taking another task, concentrates only on individual machines and develops three classes: (1) performance aid, (2) presentation aid, and (3) pure teaching machines. The latter are further subdivided into (a) general purpose and (b) special purpose (27:5). Both of these systems have much to recommend them, and the reader not familiar with this literature is urged to consult it.

However, after much consideration and examination of the problem inherent in this survey, the investigators decided on still another approach. Rather than attempt a restrictive definition, fifteen functions associated with teaching machines were identified. These functions are listed in Table II. The first seven of these functions, as indicated in the table, are basic to teaching machines as generally identified in practice and considered in the literature. To allow for leeway and for changes that are occurring constantly, we have included in this survey as teaching machines any devices that can carry out five of these seven basic functions. Thus, five out of seven of these functions became our criteria of selection.

The majority of the devices presented in this survey meet all seven of the selection criteria. Mention should be made of two classes of devices which do not. These are: (1) classroom communication systems and (2) the so-called audio-visual device. Classroom communication systems, such as the system developed by Corrigan Communications, provide an opportunity for student response and immediate knowledge of results, but in a mass situation. C. R. Carpenter of Pennsylvania State University, who began experimenting with classroom communication systems over a decade ago (2), (3), is now exploring this field further.

TABLE II

FUNCTIONS OF TEACHING MACHINES USED AS CRITERIA FOR INCLUSION IN THE SURVEY

Basic Functions

1. Used for individual instruction.
2. Contains and presents program content in steps.
3. Provides a means whereby the student may respond to the program.
4. Provides the student with immediate information of some kind concerning his response that can act as a psychological reinforcer.
5. Presents the frames of the program individually.
6. Presents the program in a pre-determined sequence.
7. Is cheatproof.

SELECTION CRITERIA: 5 out of 7

Additional Functions

8. Discriminates correctness of response.
9. Automatically advances program.
10. Provides random access to program frames allowing for branching.
11. Memory function holds out frames on which error has been made for further presentation.
12. Records results.
13. Selects program items based on evaluation of previous responses.
14. Permits two-way communication between student and machine (typewriter--computer).
15. Stores complete programs and responses.

Note: Sound and arrangements for prompting and/or cueing can be added at almost any stage. The progression listed above is not fixed or necessarily complete, but describes the pattern of capabilities in the range of machines presently existing.

The so-called audio-visual devices (individual sound filmstrip viewers, for example) are included because they can become a teaching machine with suitable methods of programing; some have already been used with oral response, and a number of others are being adapted for key response or automated answer tapes.

By definition, programed books and separate response devices cannot meet the requirements of the machine aspects of this survey. Since there is a great deal of interest in these devices, they will be occasionally treated separately in this report. Such devices are designed to simulate the functions of a machine and we use the term "simulated machine" to describe them. Any special reference to simulated teaching machines will be noted.

A Note on Programs

It is neither necessary nor desirable for purposes of this report to discuss programing theory and practice. The uninitiated reader is referred to Rigney and Fry (22) and Lumsdaine and Glaser (16). Within limits, the nature of the program used is influenced by all of the factors (and possibly more) discussed in the model teaching machine system presented in a previous section of this report.

From the point of view of the physical basis of programing, the linear, multiple choice, branching and mathetic programing theories (and combinations of these and others) can require one or more physical arrangements for presentation, response and subsequent use of information concerning student behavior. The media used, the presentation techniques and the arrangements for response also make demands upon the programer and his program.

While most programers would probably deny this vigorously, it can be argued that the preponderance of simple linear-constructed response verbal programs (Rigney and Fry reported that over 75 per cent of the programs surveyed in 1960 were of this type) is due at least as much to the ease with which such programs can be presented by a simple machine or programed book as to the overwhelming superiority of the theories of B. F. Skinner. A complicated linear program, an intrinsic or branching program and a mathetic training chain require more sophisticated means of presentation and control--more complicated machinery. The addition of auditory and visual stimuli other than words also complicates the machine requirement.

This study views the teaching machine--programed learning industry as a technological phenomenon. Programs, therefore, will be considered as the products of a growing industry bound to have an immense effect upon future instructional procedures in American education and also in terms of their technological requirements.

The technological requirement factor can be illustrated by considering the nature of the response required of the student. The usual psycho-technological reference is to the constructed response (Skinner) or the multiple-choice response (Pressey--Crowder). From the point of view of technological requirements, however, the terms written response and key response are much more meaningful. A constructed response may be written on a typewriter (key) and a multiple-choice response may be written instead of punched on a set of keys. In discussing machines in this report, the latter terms will be used.

SECTION IV

MACHINES AND PROGRAMS: THE GENERAL PICTURE

This section will present a general analysis of the results of the survey of the teaching machines--programed learning industry. For the most part, the important information is presented in graphic form with a minimum of discussion. Following sections will present the actual directories of machines and programs.

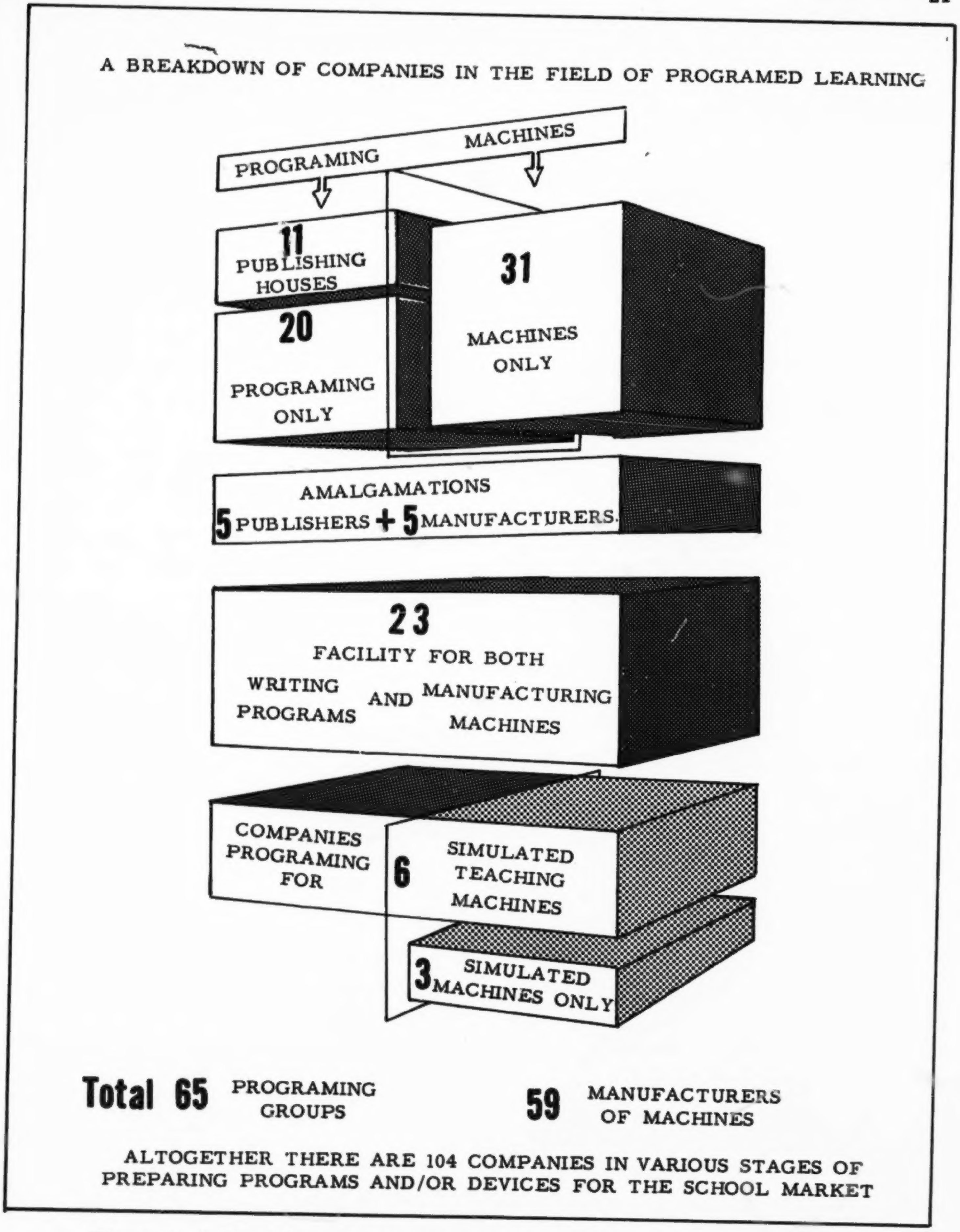
A Picture of the Sample

Figure 1 is a breakdown of the 104 companies which cooperated in the survey, showing an approximately equal number of companies occupied in producing hardware and writing programs. Not all of the eleven publishing houses have their own program writers.

It is notable, however, that thirty-one manufacturers of machines do not have programing facilities of their own, and this will be reviewed in a later diagram relating the development of devices to the acquisition of programing facilities. Many of the twenty programing groups not linked with manufacturers do contract programing, sometimes for publishing houses, but most often in conjunction with the manufacturers of hardware. This is usually done either for research or for use within schools or school systems.

The recent amalgamation of five major publishing groups with five counterpart manufacturing groups illustrates a growing trend, and many other publishing houses are considering the advisability of allying themselves with the producers of hardware. Those smaller companies with the dual facility for producing programs and hardware fall into two groups--programers who saw the need for a machine either to control the presentation of information, or, in some cases, as an added sales feature for their programs. Others are companies who set out to manufacture devices and found that programs were necessary to create a market for their products.

The group called "simulated teaching machines," as mentioned previously, consists of those which met less than five of our criteria. Some programers found the lower cost and expendability of these devices an advantage--so much so, in fact, that three companies are active in producing this kind of hardware (special notebooks, etc.).



ALTOGETHER THERE ARE 104 COMPANIES IN VARIOUS STAGES OF PREPARING PROGRAMS AND/OR DEVICES FOR THE SCHOOL MARKET

Figure 1. A Breakdown of Companies in the Field of Programed Learning

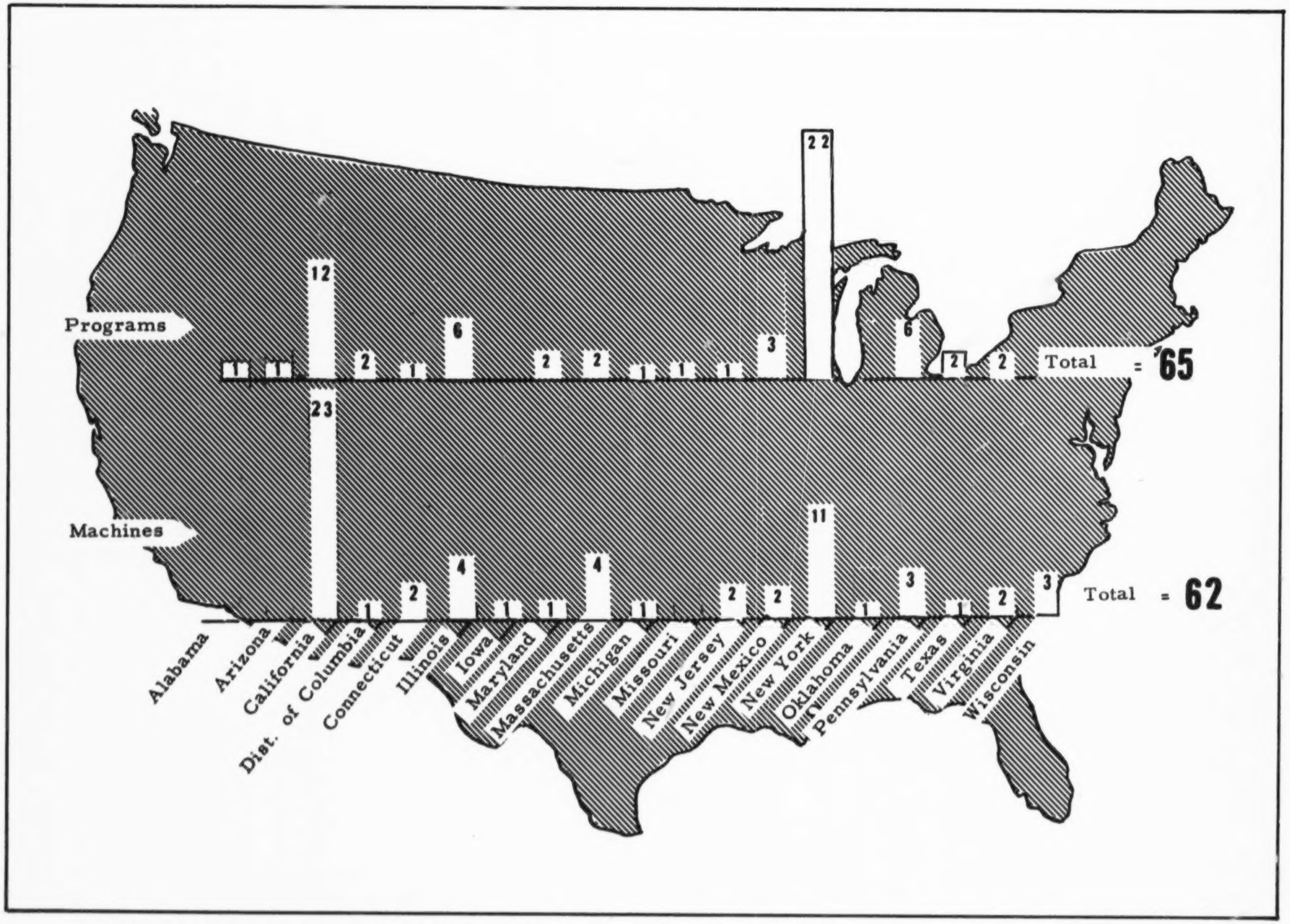


Figure 2. Geographical Distribution of Companies Manufacturing Machines and Producing Programs

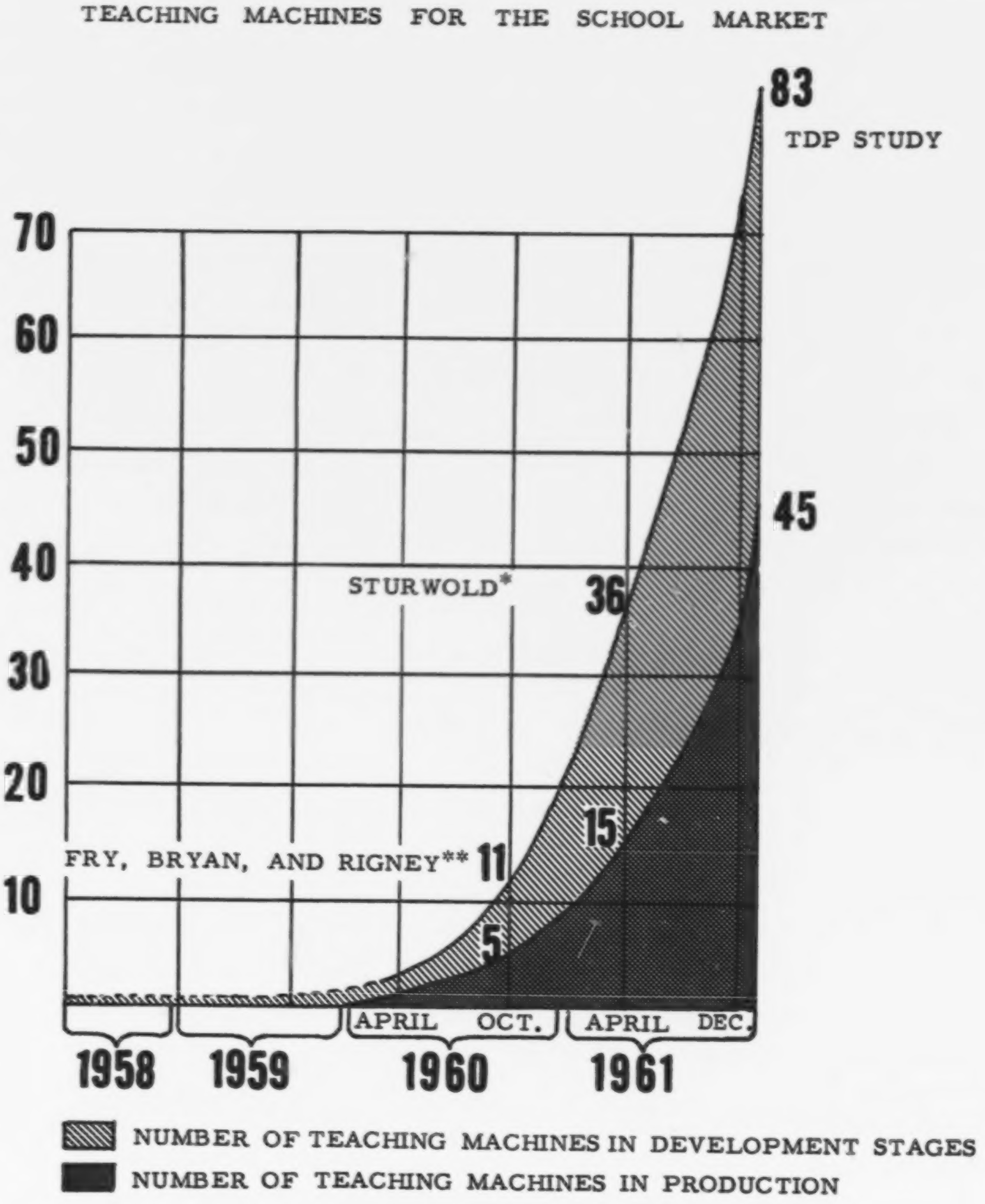
Looking at the national distribution of these various companies shows some points of interest, illustrated in Figure 2. California is the major producer of hardware, which is not surprising considering the concentration of electronic and engineering companies in Southern California. New York is as dominant in the area of programing as California is in hardware, and this is due in part to the large number of publishing houses which have their main offices in New York City. So far, only nineteen of the fifty states are known to have companies producing programed learning materials for the open market.

Fry, Bryan, and Rigney published a report in October, 1960, listing eleven machines produced for sale, of which only five were actually in production at that time, so far as can be ascertained (11). Another report in Audiovisual Instruction some six months later listed thirty-six teaching machines, of which only fifteen were in production at that time (10). The present study has located eighty-three teaching machines in various stages of development, of which forty-five are in limited or full production. The growth curve is plotted historically in Figure 3.

In developing the graph, it was assumed that each of the earlier reports was as complete as was possible at the time it was made. The data from these reports have been subjected to the same criteria of selection used in this survey.

Assuming that the delays in publication might have been longer in the case of the previous reports, the graph would appear somewhat less steep. However, it is obvious that a wide variety of hardware is being developed, and the number of companies active in producing machines is increasing. Incidentally, the number of machines should not be confused with the number of companies. The eighty-three machines listed are manufactured by the same sixty-two companies listed earlier. There are numerous variations of basic models, so another criteria used in selection was that there must be a distinct difference in function for more than one model to be listed, and the maximum number for any company would be three. This same policy is reflected in the choice of machines shown in the pictorial directory in the following section.

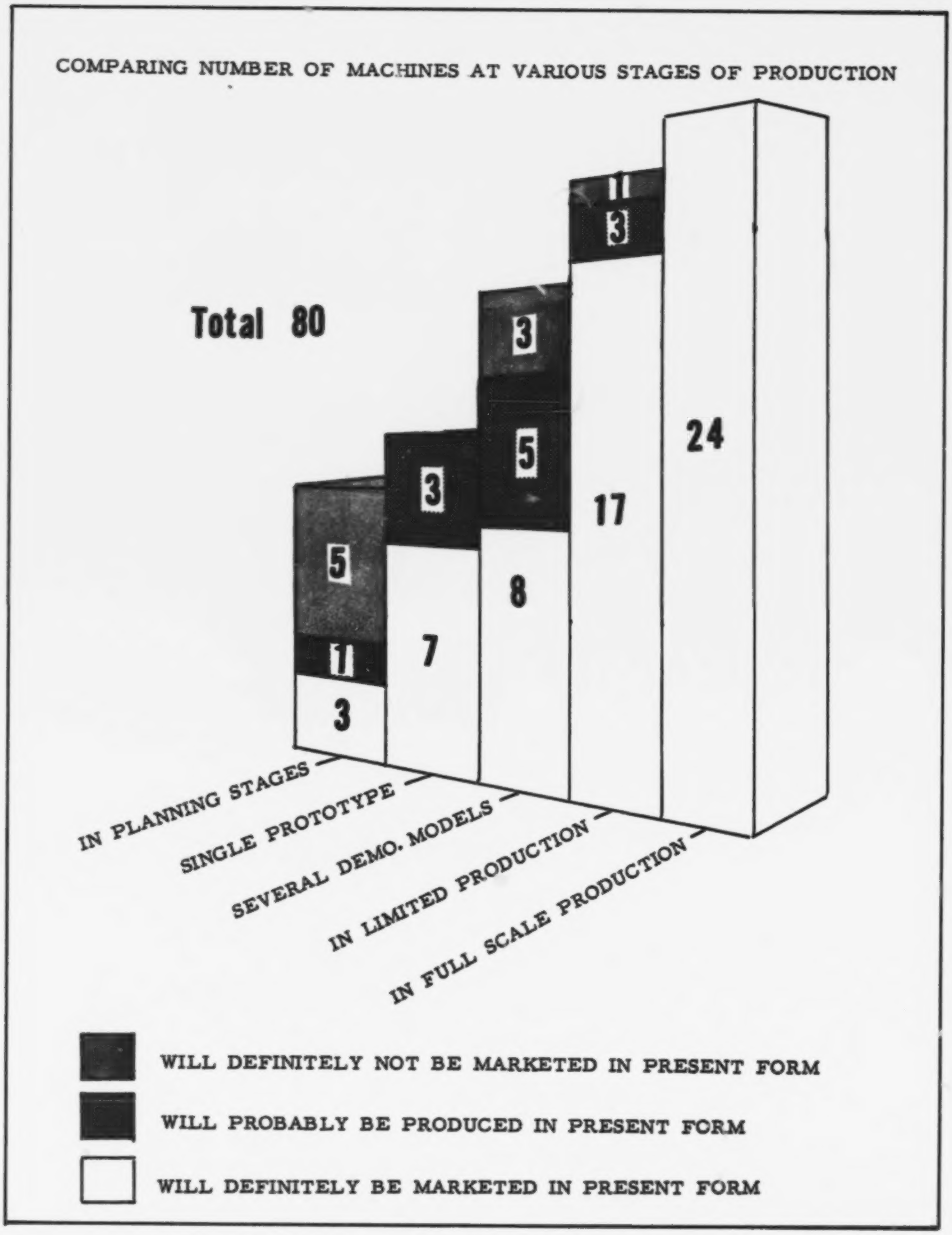
Figure 4 breaks down the eighty machines for which information was supplied according to the phase of production. The shaded areas indicate possible changes which are anticipated before full-scale production is reached. The graph is probably least accurate for the planning and single prototype stages because most companies prefer not to disclose their activities at this stage of operation. For each company that does not eventually go into production, however, there is probably another company in the planning stages which will. Overall, the picture expressed by the graph is thought to be a fair approximation.



[*] Sturwold, Virginia G., "Sources of Self Instructional Devices", Audiovisual Instruction, Vol. 6 No. 4 (April 1961), pp 144-45.

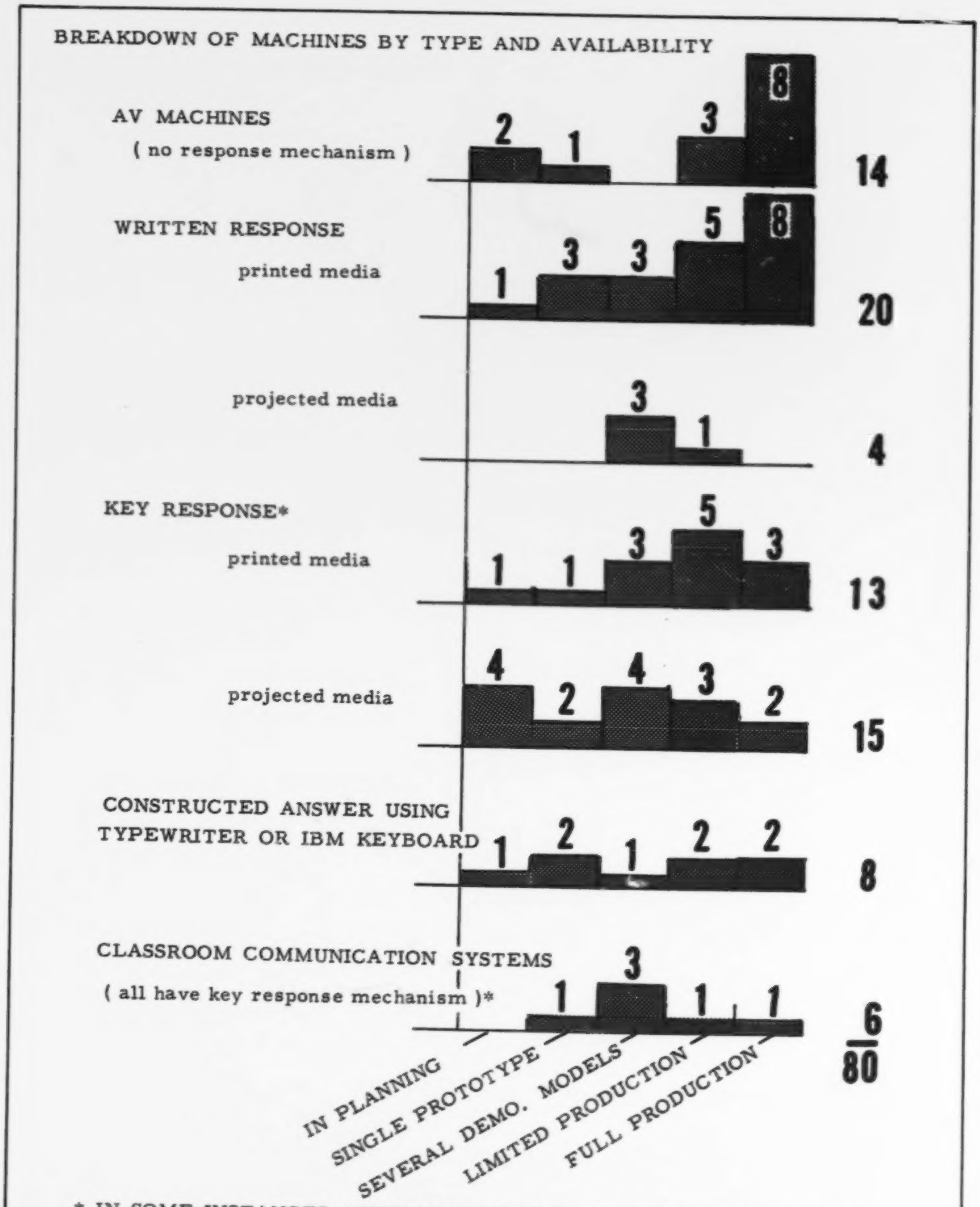
[**] Fry, Bryan, and Rigney, "Teaching Machines: an annotated bibliography", Audio Visual Communication Review, Vol. 8 No. 2 (October 1960), pp 75-79.

Figure 3. Teaching Machines for the School Market



COMPARING NUMBER OF MACHINES AT VARIOUS STAGES OF PRODUCTION

Figure 4. Comparing Number of Machines at Various Stages of Production



* IN SOME INSTANCES AUTOMATED ANSWER TAPES ARE AVAILABLE IN ADDITION TO THE KEY RESPONSE DEVICE.

Figure 5. Breakdown of Machines by Type and Availability

From the point of view of media, machines using a paper program with constructed or written response are the most popular at present (see Figure 5). Of twenty such devices under development, thirteen are already in production. Key response with printed media is likewise well developed but not to the same extent.

The projected media show a lag regardless of the form of response used, and obviously the key response is much more popular than automated answer tapes. The form of the graph does not indicate, however, that a number of film devices (filmstrip, slides) having multiple-choice response also have provision for automated answer tapes to allow for constructed answers as well.

A number of machines are under development using more complex keyboards, such as typewriter keyboards, alpha-numeric inputs, etc. Devices of this type are likely to increase considerably in number, especially those for teaching psychomotor skills such as typing and key punch operation.

A number of classroom communication systems have appeared over the past year, and these use mass presentation with individual response. Usually the response is by pressing keys, which makes possible an immediate percentile score for the teacher to determine how effectively a concept has been taught, and it also facilitates research and development of programs and programing techniques.

Figure 6 gives a breakdown in price for all but the more sophisticated computer-operated devices and for highly sophisticated classroom systems. There is a price differential of $50 to $100 between a paper device and the equivalent film (filmstrip, slide) device; however, greater flexibility is afforded by the projector machines in programing and operation, and the storage problems for programs is greatly lessened.

The extensive availability of projector-type machines in the $300 to $600 category can be attributed to the usefulness of the audio-visual machine for industrial assembly operations in the form of a production prompter or performance aid. Many of these are now being modified for school requirements to include response mechanisms, and a number of lower-priced models are becoming available.

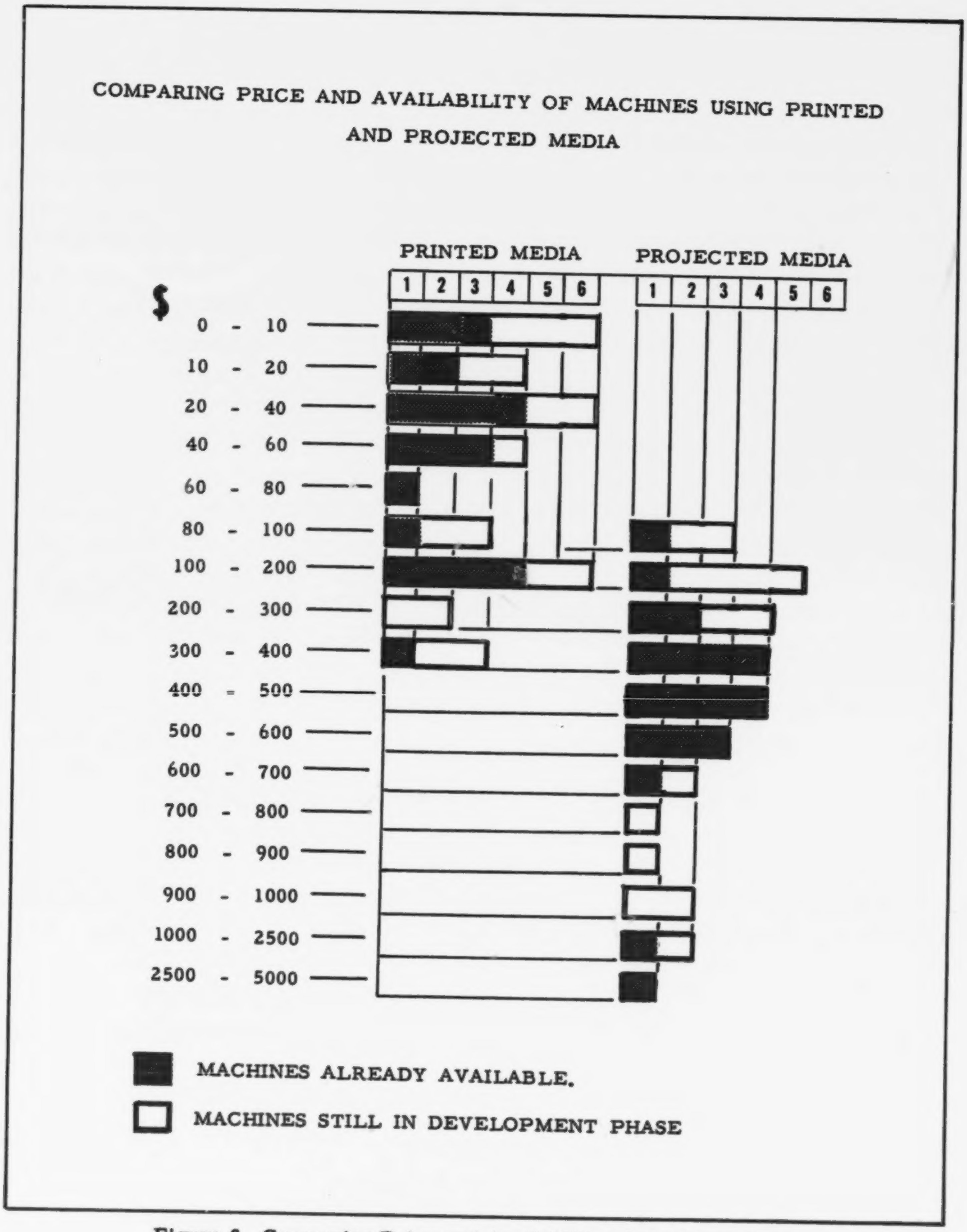


Figure 6. Comparing Price and Availability of Machines Using Printed and Projected Media

Some producers of hardware have entered the field before considering the necessity of "software" in the form of programs, and this apparently continues to be the case if the correct data were supplied to us by the manufacturers. Figure 7 shows an increase from 20 per cent to 75 per cent of the hardware manufacturers acquiring programing facilities (or contracting this service to other companies) over the period from planning to full production. In plotting this graph, the classroom systems and audio-visual machines were purposely removed because it is usual to have custom programs specially made for these devices, or else the user prepares his own programs.

Words, pictures, and sounds may be used on various media, according to the kind of machinery available for presentation. The visual portion of a program may be on paper sheets, cards, discs, paper roll or fan-fold paper, in books, on slides or filmstrips, motion picture film, or even computer tapes, punch cards, or the like. Figure 8 breaks down the various teaching machines according to the media carrying the program. In addition, there are fifteen companies publishing programs in book form, and several more using paper devices to simulate machine functions.

Figure 9 presents graphically the programs reported by the respondents to the survey. This information was requested in two parts--programs available during 1961 and programs becoming available sometime during 1962. The information presented in Figure 9 is subject to some interpretation and should be regarded as an approximation.

The conditional nature of Figure 9 is due to several reasons. Publishers and other program producers are hesitant to state categorically that a given program will actually be out on a specific date. Several months leeway may be necessary. Generally speaking, the overall figures are probably conservative because several companies are not ready to disclose information on their activities at this time, and some research programs may be made available to the school market.

In this overall graph, in addition, care should be taken as to the interpretation of the word "program." As mentioned in the foreword to the directory section, the length, scope and coverage of a given program is a better indication of the state of programing than merely counting up programs by numbers. Some programs on this graph may be finished in one-half hour; others are a semester in length. Details on the programs reported upon, insofar as they are known, are presented in the directory section.

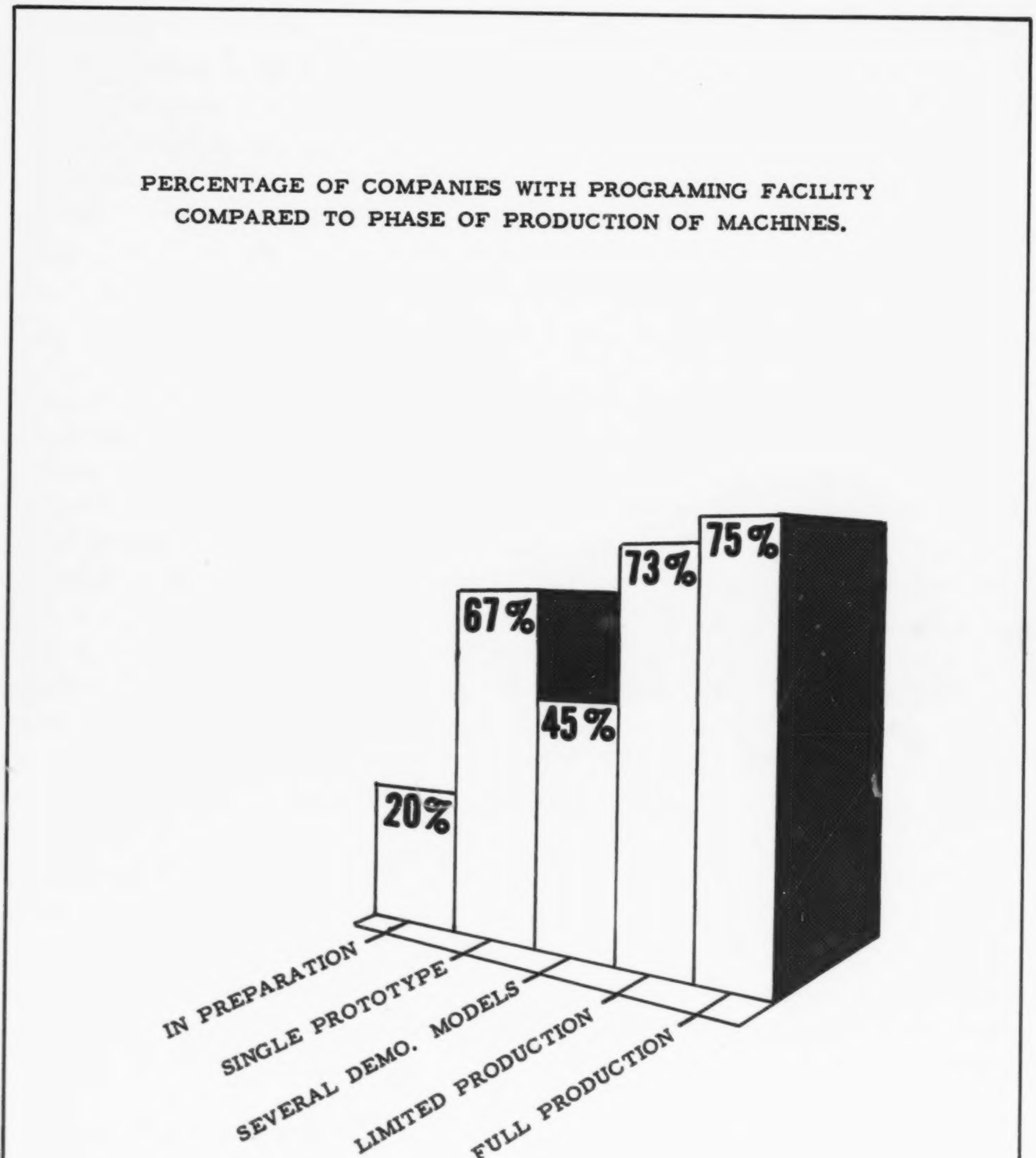


Figure 7. Percentage of Companies with Programing Facility Compared to Phase of Production of Machine

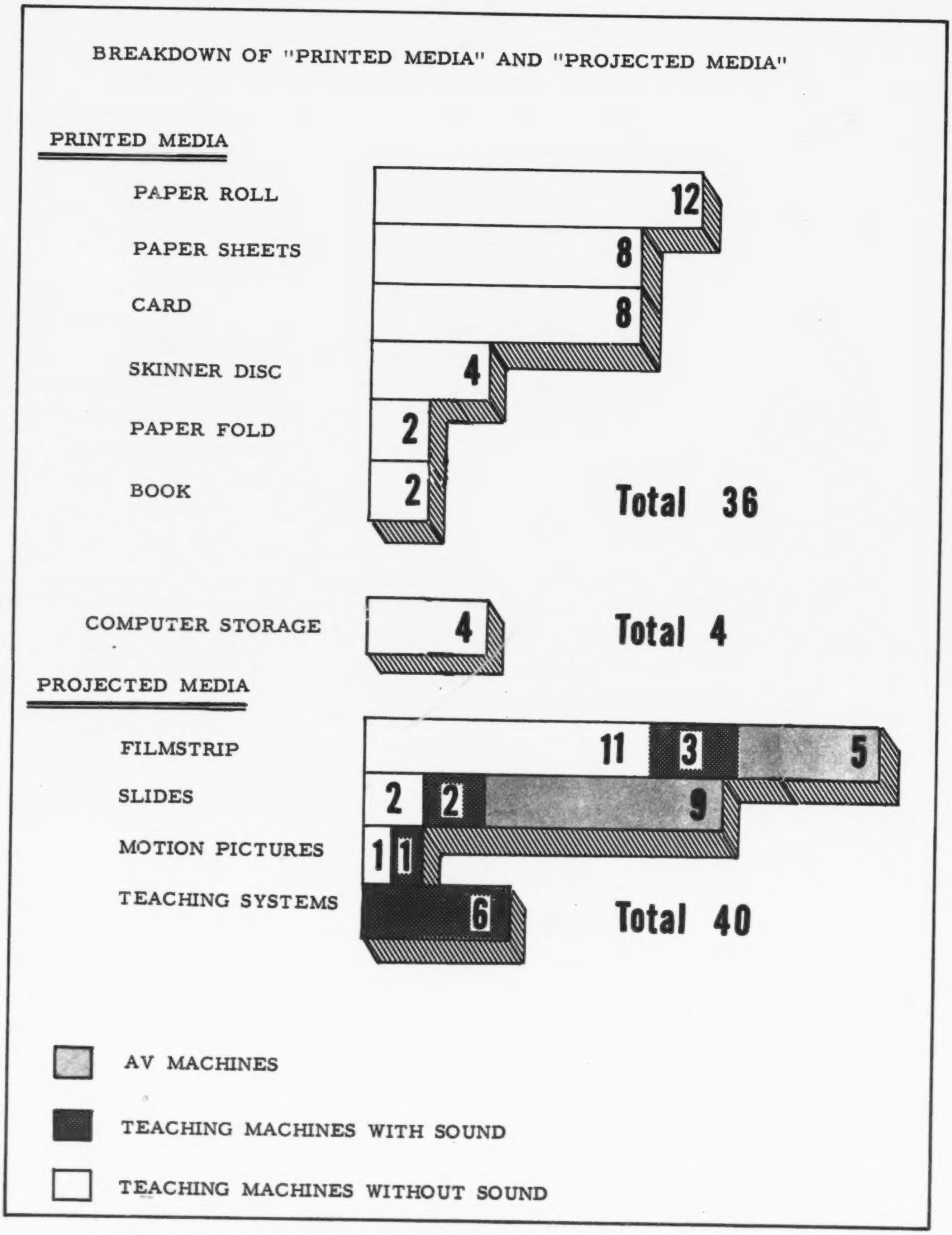


Figure 8. Breakdown of "Printed Media" and "Projected Media"

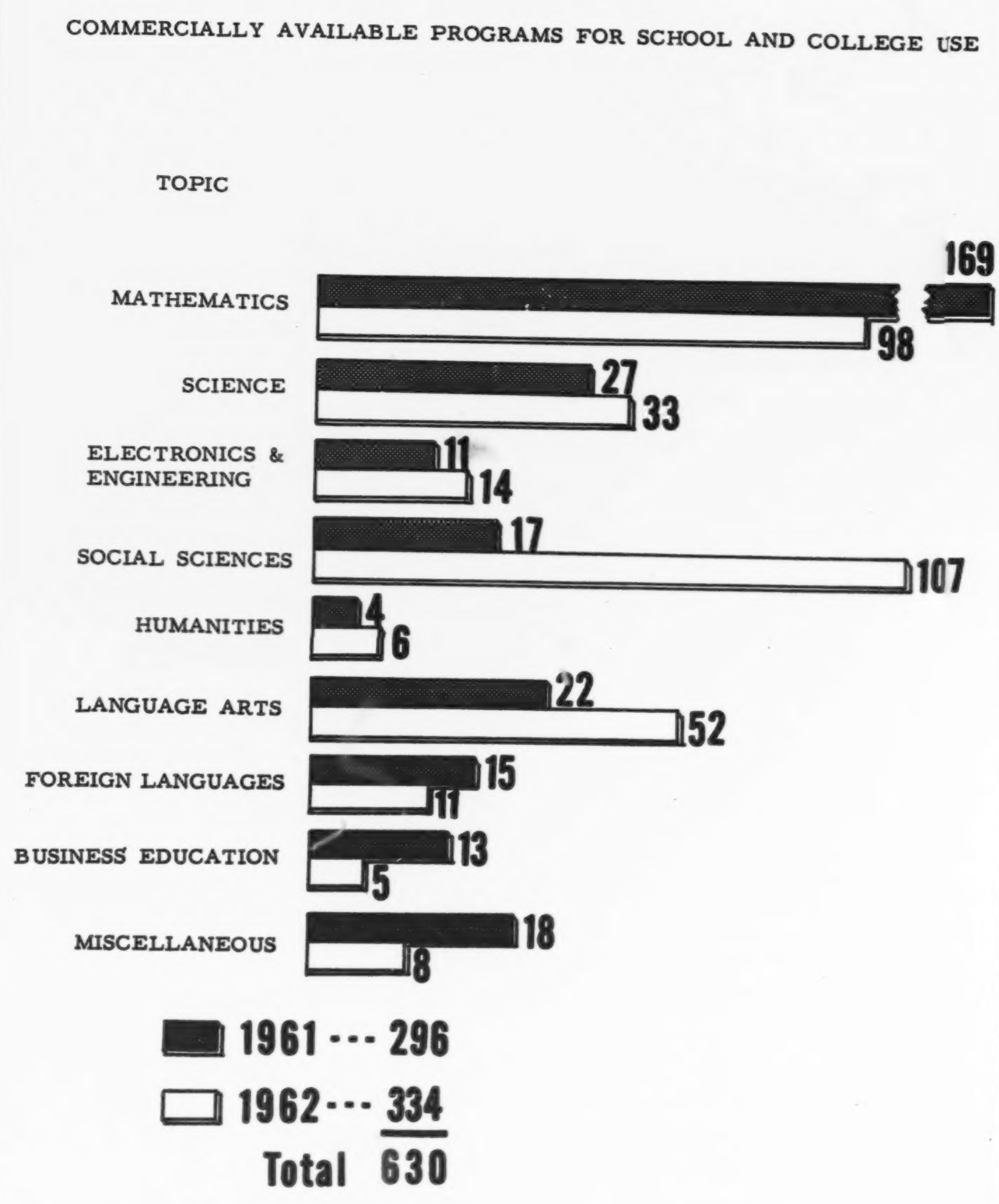


Figure 9. Commercially Available Programs for School and College Use

SECTION V

DIRECTORY OF MACHINES

The pages which follow present a photographic directory of nearly 100 teaching devices, of which approximately eighty per cent met the requirements of the survey of teaching machines reported in the preceding section. The balance are of the simulated machine type, which we have included in the directory in order to give a complete picture to interested educators.

Sections of the directory are organized, for the most part, on an ascending scale of sophistication beginning with categories including the simplest and least expensive equipment and progressing through various grades of more complicated design to computer-controlled and classroom communication devices. The educator interested in these machines is advised to contact the manufacturer directly by referring to the Directory of Manufacturers and Publishers which appears as Section VII of this report.

Direct contact with manufacturers is encouraged due to the changing state of the art and the variable requirements which educators and research workers may have. It should be emphasized that listing in this directory does not imply any endorsement of the equipment whatsoever by the Staff of the Technological Development Project or any of its sponsors. There are, at present, no standards in this field and there has been relatively little field testing and/or experience with this equipment. One of the purposes of the directory is to provide information to the field so that those desiring to experiment may know where to look for devices of the type desired.

It should be noted that a joint committee of three national organizations, the American Educational Research Association, the American Psychological Association and the Department of Audio-Visual Instruction of the NEA is now beginning to work on standards in both the programing and machine fields. Interested educators are urged to read the initial statement of the joint committees which has appeared in many educational journals[x] and to look for further statements as they are released.

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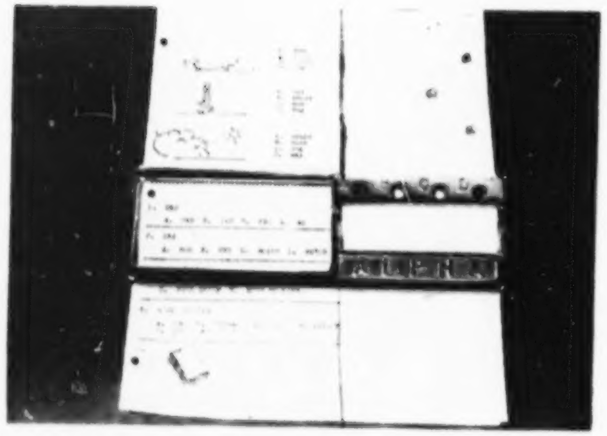
[x] See, for example, the Audio-Visual Communication Review, May, 1961, pp. 206-208. This statement has also appeared in the NEA Journal and many other publications.

Existence of a device is not necessarily a guarantee of immediate availability. During the course of this survey, many model changes and other adjustments in design and production have been observed--all of which may interfere with immediate availability. Again, interested persons must check with the manufacturers.

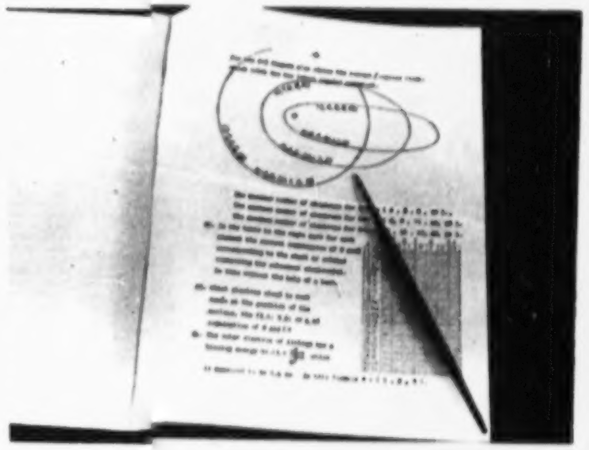
The descriptions provided in the directory are limited to functions that are important to the particular device referred to. The educator desiring to try self-instructional devices should be clear as to the functions he desires in his instrumentation. Generally speaking, the more control put into the program, the response and the reenforcement, the more sophisticated the equipment required. The media desired is also an important factor to consider. Printed media tend to limit the programs to verbal material and the responses to verbal behavior. Audio-visual media add several dimensions to the stimulus, and provisions for an audio response change the nature of the behavior required of the student. The basic point, to repeat, is that the educator must know what it is he wants to do before he is qualified to select an instrument to do it.

Printed Media: Simulated Teaching Machines (1)



A-Alpha Pattern & Mfg. Co.: ALPHA

Masking device for written response. Multiple choice responses can be punched on attached paper strip with unsharpened end of pencil. Markings beneath indicate correct response.

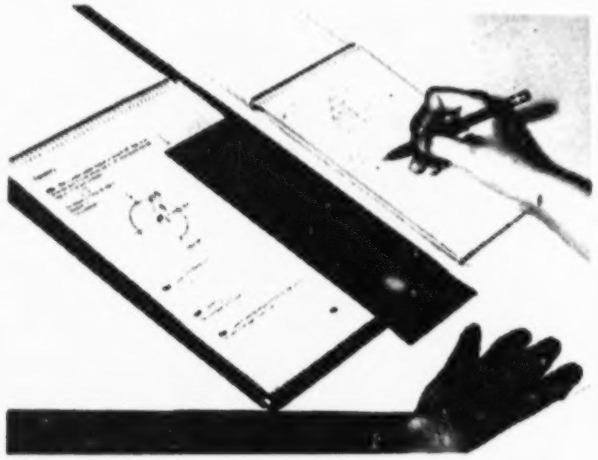


Consolidated Litho: AUTOSCORE

Chemical in answer sheet turns red or green on moistening, providing immediate knowledge of results and cheatproof answer system.

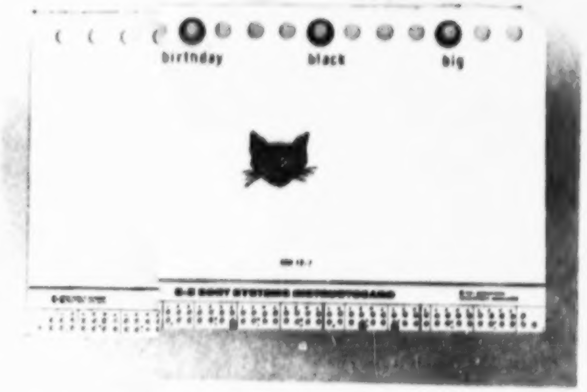
Dyna Slide Co.: VERTIMASK
SLIDE-A-MASK

The student uses either of these devices to unmask the program at his own rate.



Encyclopaedia Brittanica Films: TEMAC

Program designed for use in special folder with integral sliding mask. Student responds on separate answer sheet, then compares his answer with the one provided.



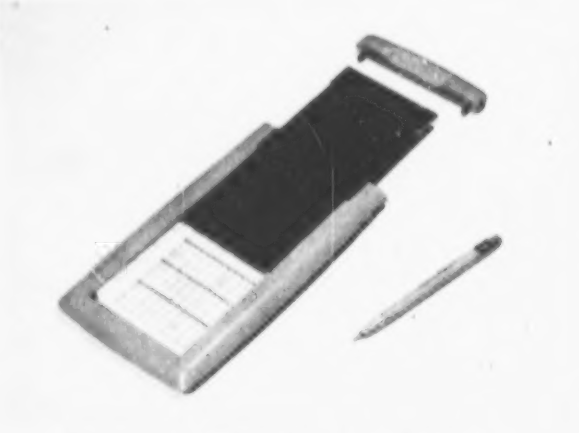
E-Z Sort Systems: E-Z SORT INSTRUCTOCARD

Edge-punched cards, selected with a sorting stick, guide the student through the program. Use of cards enables a single program to be shared among a group of students.

General Atronics: ATRONIC PORTABLE TAG

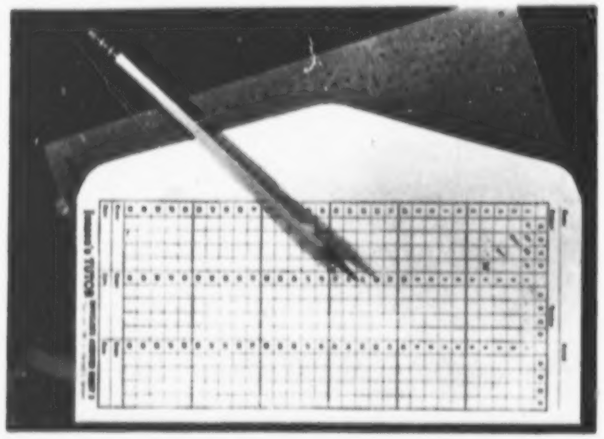
Answer sheet with provision for written and multiple-choice responses. Program must be keyed to specific answer plate. Ball point pen punches out hole for correct answer.

Printed Media: Simulated Teaching Machines (2)



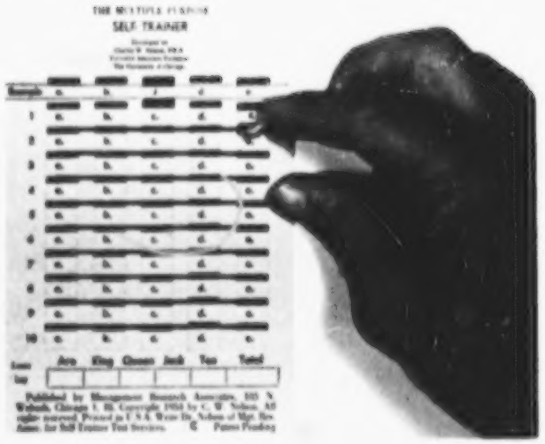
Instrument Research: PUNCHBOARD

Punchboard uses enclosed IBM card for scoring and tabulating. Correct answer causes punching tool to enter full depth of hole, reinforcing student response. Cheatproof.



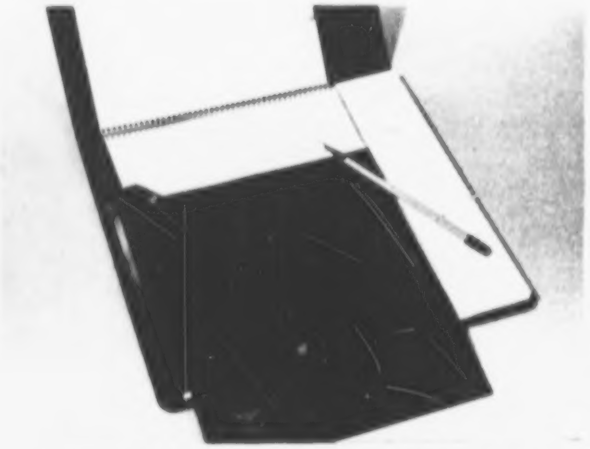
Jensen, Gerald L.: JENSEN'S TUTOR

Envelope answer sheets in 7 formats and 25 answer patterns which can be inverted and turned over. Pencil or ball point punctures correct answer square.



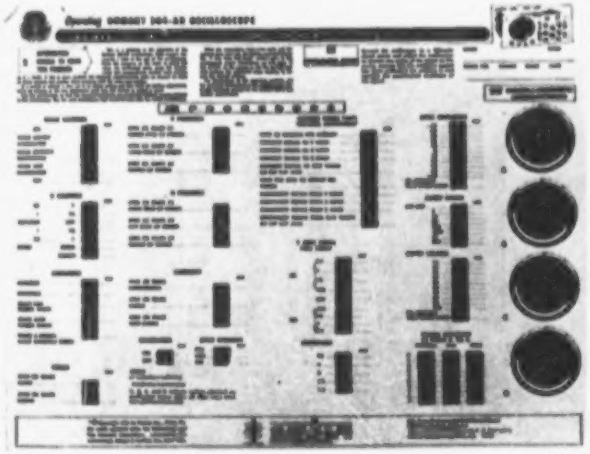
Management Research: SELF TRAINER

Answer devices in several formats for either 10 or 24 multiple-choice questions. Student selects from 5 possible answers and pulls tab to disclose score. Cheatproof.



National Blank Book Co.: LEARN EASE

Folders and binders for programed learning materials with mask on sliding track. Can be made to open at side or end.



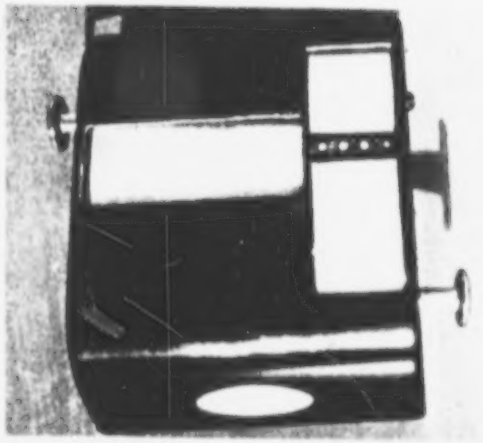
Renner, Inc.: TRAINER-TESTER

Multiple-choice programs with answers masked by a silver overlay. Student erases overlay adjacent to his choice and is appropriately reinforced.

Van Valkenburgh: TRAINER-TESTER^R

Laboratory Equipment Simulator Kits include written information, charts, and diagrams, with special answer sheets where student erases silver overlay to confirm his answer.

Printed Media: Written Response (1)



A-Alpha Pattern & Mfg. Co.: ALPHA

Paper roll with separate answer tape. Multiple-choice responses can be punched with unsharpened end of pencil; markings beneath indicate a correct response. Cheatproof.

Avta Corporation: AVTA 110

Six-inch paper roll in replaceable cartridge with separate answer tape. Cheatproof. A variety of models is available.

Avta Corporation: AVTA 440

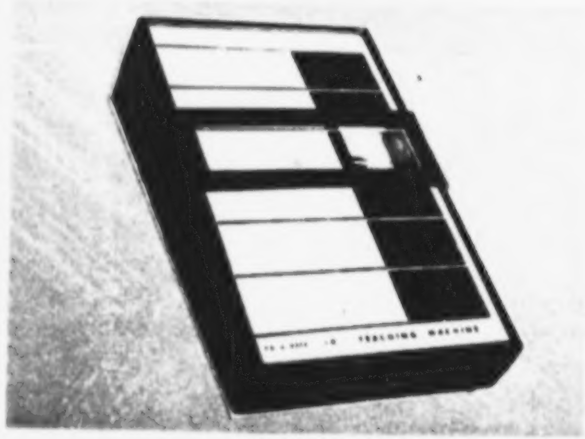
Six-inch paper roll with separate answer tape in easy-loading cartridges. Built-in sound unit allows audio-visual programs. Cheatproof.

Billerett Company: TM-3 DISCOVERER

Paper roll program with wide answer tape and large writing space for responses. Cheatproof. Student star-punches right answers to facilitate correction.

Consolidated Litho.: EDUMATOR

Paper roll program printed both sides; separate answer tape can be attached. Low cost cardboard construction. Can stack on shelf like book.



Ed-U-Cards Mfg. Corp.: ED-U-DATA

Program on paper sheets. Student responds, then presses answer area for reinforcement. A light underneath allows the correct answer to be seen through the paper.

Printed Media: Written Response (2)

Field Enterprises: CYCLO TEACHER

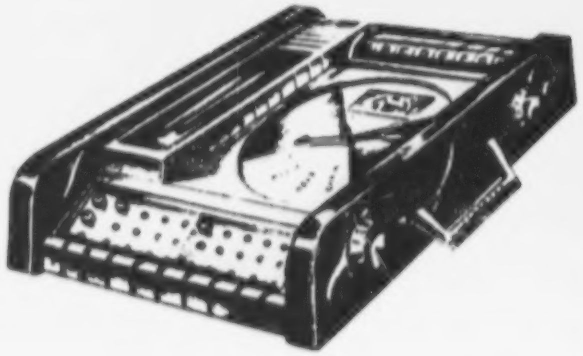
Programs on discs with separate answer wheels. Reviews and tests information presented in the World Book Encyclopedia.

Hamilton: VISITUTOR

Card programs with separate answer sheet. Advancing program also advances answer sheet. Wrong answers must be correctly written alongside incorrect responses.

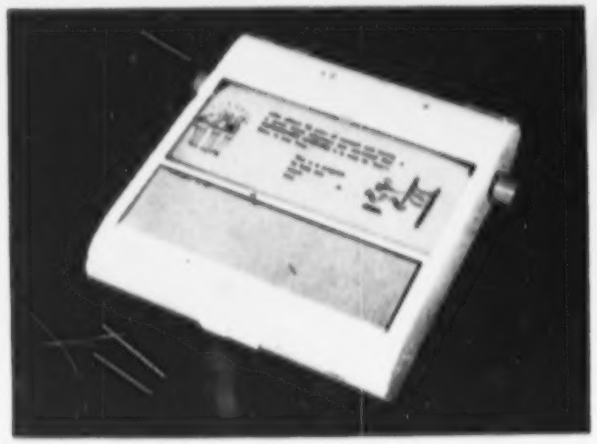
Koncept-O-Graph Corp.: KOG-7

Program on 8½ x 11 mimeograph paper with separate answer tape. Cheatproof. Can accommodate a range of available programs. Left and right hand operation.



National Communications Labs.: MODEL #3

Intended as a learning game for individual *and group use. Program on 5 x 5 paper sheets* inserted into a pliofilm belt. Sand timing device and storage for extra programs.



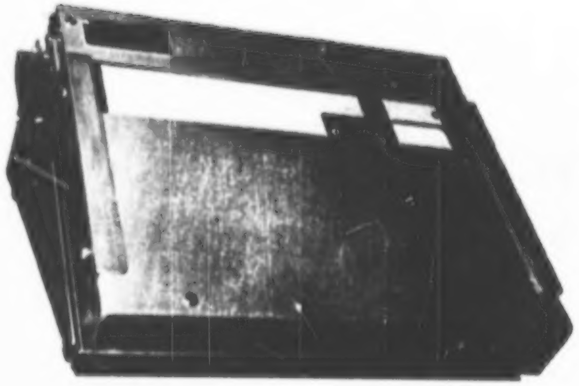
National Ed. Systems: RESEARCH MODEL

Scroll paper program 8" wide. Erasable *answer pad for written* answers. Storage space inside machine for additional programs.

Programed Teaching Aids: FERSTER TUTOR

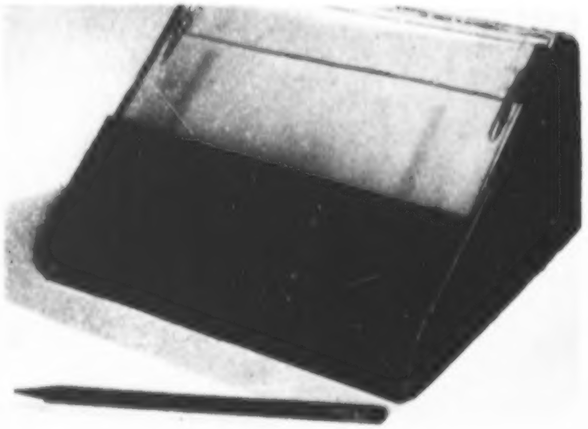
Roll 6" wide with separate answer tape or 8½" wide with answers written on program. Forty-ft. roll printed both sides gives large storage capacity. Sturdy board construction.

Printed Media: Written Response (3)



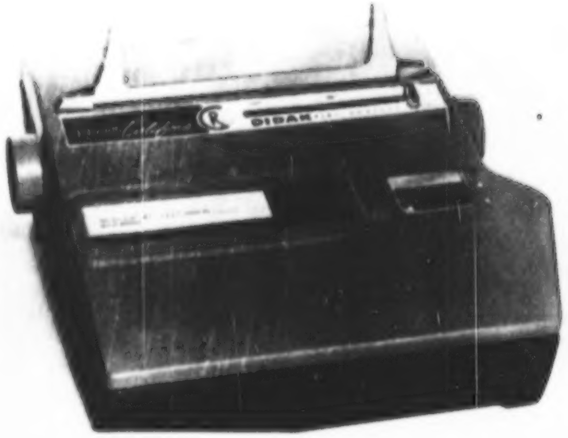
Programed Teaching Aids: FORINGER 2002

Program on 8½" wide fan-folded paper with separate answer tape. Interchangeable viewing apertures; prompting; cheatproof.



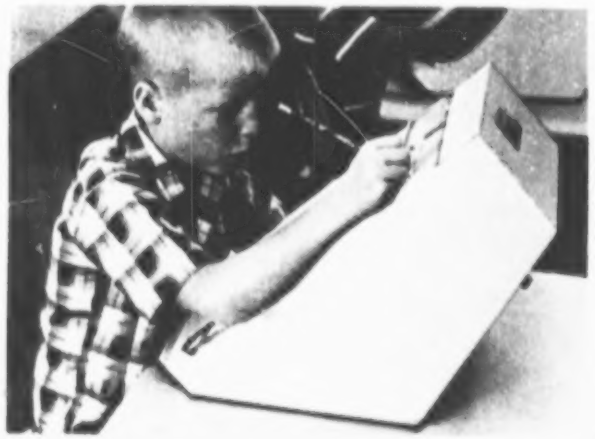
Staten, J.F.: (no name)

Plastic cartridge for paper roll program. One way rachet makes cheatproof. Large viewing aperture allows a range of program formats.



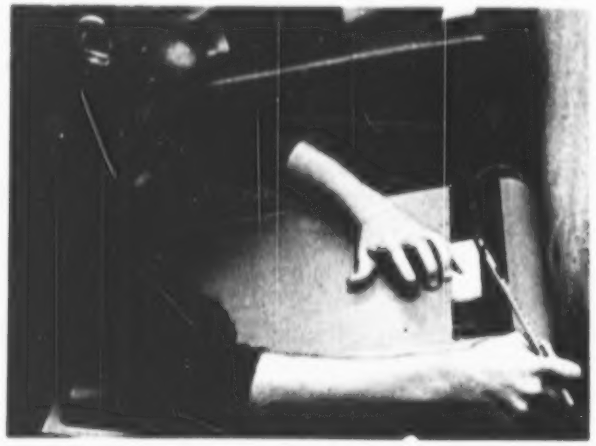
Rheem Califone: DIDAK 501

Program on 8½" wide fan-folded paper with separate answer tape. Variable depth viewing aperture; prompting; cheatproof. Student actuates scoring device.



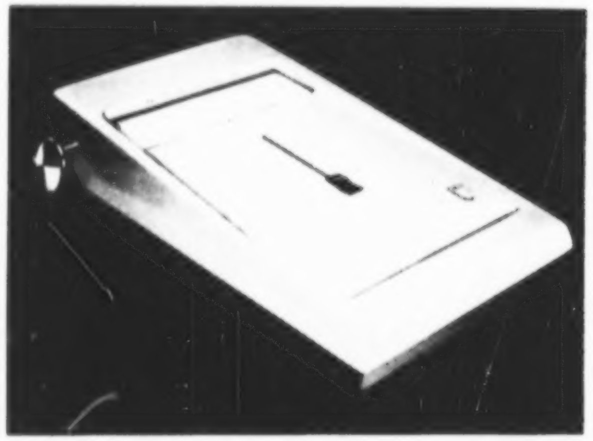
Teaching Machines: MIN/MAX (home model)

Program on half or full width of 8½ x 11 paper sheets. Interchangeable viewing apertures. Cheatproof. Program advanced with eraser end of pencil.



Teaching Machines: MIN/MAX Model II

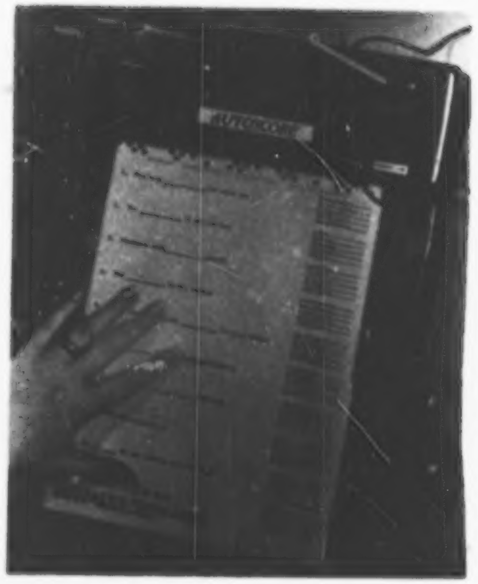
Program on half or full width of 8½ x 11 paper sheets. Interchangeable viewing apertures. Cheatproof. The Model II is especially designed for use in schools.



Universal Electronics: UNIVOX

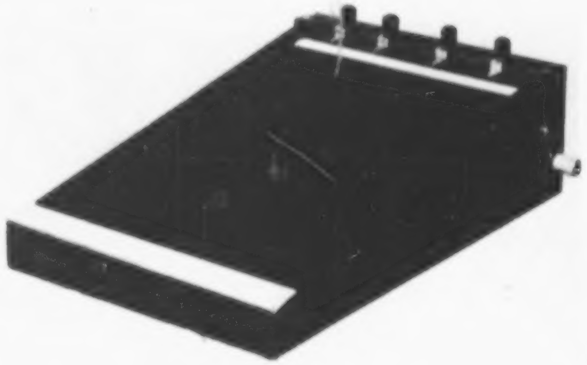
Programs on 8½ x 11 paper sheets. Cheatproof. Front opening for easy loading.

Printed Media: Key Response (1)



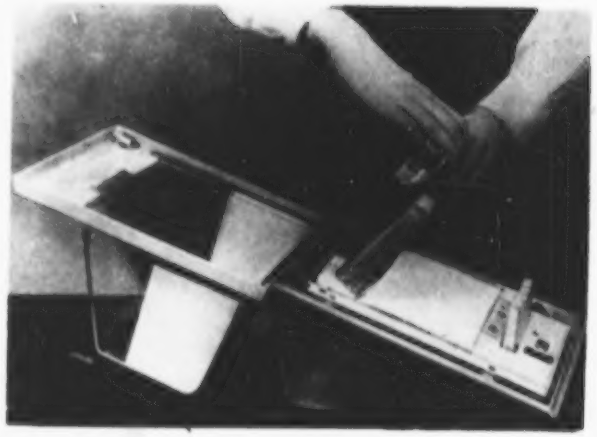
Astra: AUTOSCORE Model A Mark II

Program on cards 8½ X 11½. Answer code punched at top. Light cues question to be answered, electric probe records response. Five choices. Cheatproof.



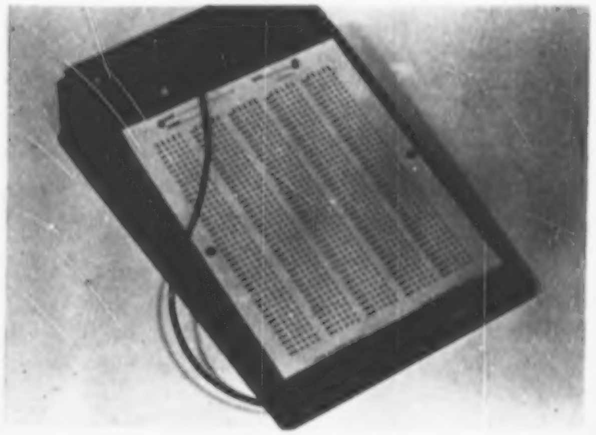
COMPARATOR (arithmetic trainer)

Program on 8½ X 11 mimeographed sheets or workbooks. Response is made by setting indicators at top; correct answer is rewarded by click in earphone.



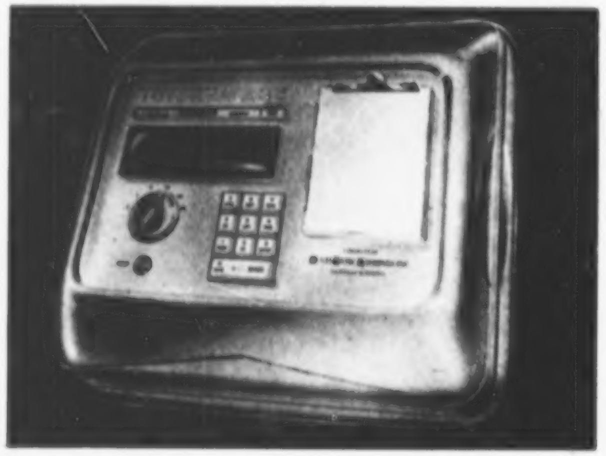
General Atronics: ATRONIC TUTOR 580

Program in 6 X 6 books. Four choices, page turns when correct key is pressed. Counter registers total number of responses.



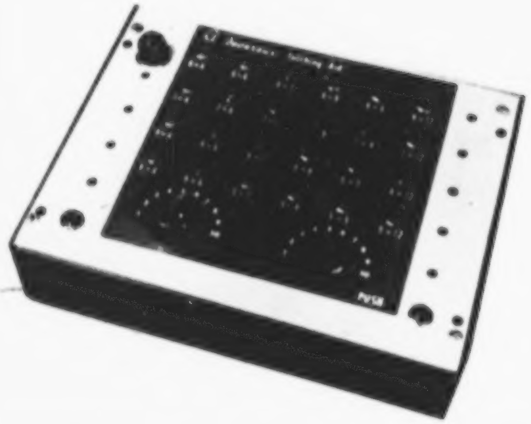
HRB-Singer: STAR 2760

Uses separate program; 8 X 10½ answer sheets come in a variety of patterns. Electric probe records number of responses. Correct answer flashes light.



MultiMatic: TUTOR-MATIC

Programs printed on disc; response by alphanumeric input. Scoring and timing facility enables both teaching and testing modes. Two machines can be electrically connected for competitive practice. Several models.



Smith Harrison: DEVEREUX TEACHING AID #90

Twenty-four multiplication problems permanently arranged. The student sets answer on rotary switches. Light or buzzer reinforces correct response. Cheatproof.

Printed Media: Key Response (2)

Smith Harrison: **DEVEREUX TEACHING AID #50**

Workbook sits on face of machine between two rows of push buttons. Student sets response pattern and selects appropriate answers. Correct response reinforced by light and buzzer.

Smith Harrison: **DEVEREUX TEACHING AID #80**

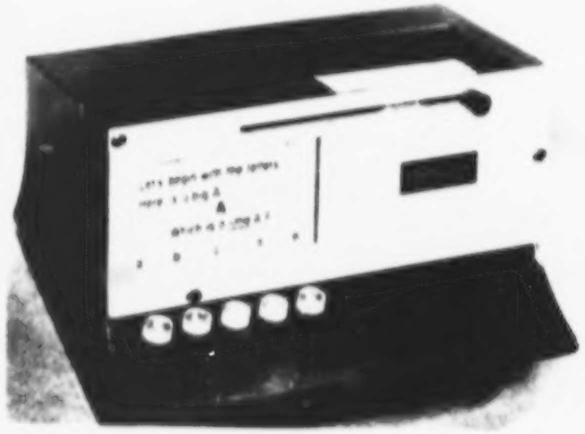
Special card programs. Student sets response pattern. Six items appear on each card, each of which requires three responses selected from six possibilities. Cheatproof.

Rheem Califone: **DIDAK 601**

Program on 5" fan folded paper. Student presses window covering selected answer. Correct response advances program. Automatic scoring; also allows item analysis.

USI Robodyne: **MEMOTUTOR**

Program on paper rolls. Students match item on right with item on left. Error count by machine.



U.S. Photo Supply Co.: **OMNIBOX TEACHALL**

Five choices of 3 x 4½ program cards. Correct response drops card, rings bell, and green light glows.

Projected Media: Audio-Visual Machines (1)

American Systems: INSTRUCTRON

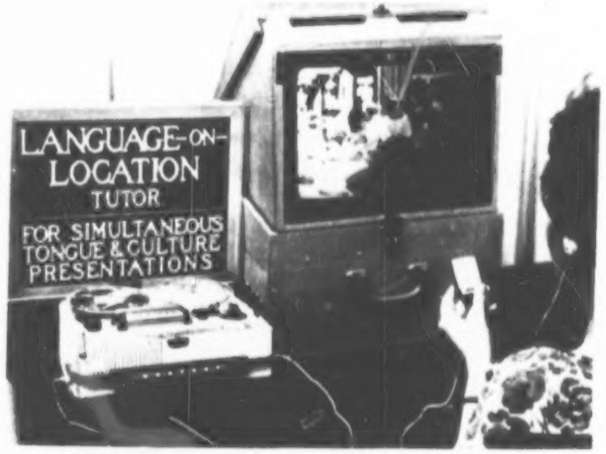
Sixteen millimeter film synchronized with tape cartridge.

American Systems: INSTRUCTRON M/61

Program as a chain of envelopes, each containing a 35mm film chip and a standard dictating machine record. Automatic feed; can stop, skip, or repeat frames.

ACS PORTABLE AUDIO-VISUAL UNIT

Program on 35mm slides synchronized with 1-7/8ips tape cartridge. Fast forward-rewind. Operator or machine paced. Key response device under development.



Anirama: LANGUAGE-ON-LOCATION TUTOR

Program on 35mm single frame film in high capacity filmstrip-belt-magazine synchronized with tape recorder. Student can control forward-reverse change of picture.

DuKane: AV-MATIC

Single-frame 35mm filmstrip advances automatically in sync with a disc recording.

Execugraf: EXECUTIVE MODEL #300

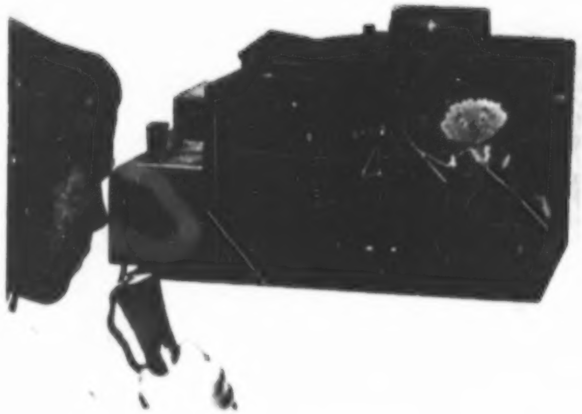
Double-frame 35mm filmstrip cartridge synchronized with 3-3/4ips magnetic tape in separate cartridge. Forward and reverse on film. Several models.

Projected Media: Audio-Visual Machines (2)

Graflex: **AUDIO GRAPHIC INSTRUCTOR**
(language lab model)
Slide and filmstrip models having 3-3/4ips tape cartridge. Three track sound provides instructor's voice, sync for forward-reverse, and track for student to record responses.

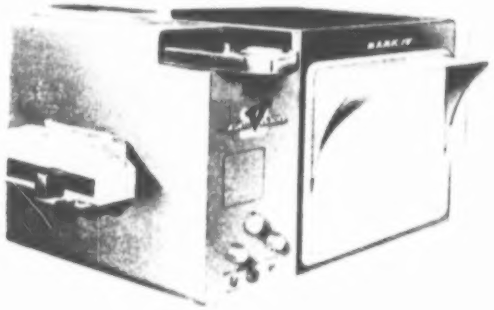
Gray Mfg. Co: **D-SCOPE PROJECTOR**

Audioslides have up to three minutes of sound in spiral groove, 35mm slide in center. Facilitates programing sound-slides in any order



LaBelle: **TELEGUIDE**

Uses 35mm slides or filmstrips in conjunction with magnetic tape or records.



Lectron: **AUDIOVISION MARK IV**

Magazine for 35mm slides synchronized with cartridge loading tape.

Picture Recording Co.: **MODEL TR-1655**

Program of 35mm slides synchronized with magnetic tape. Machine or learner paced.

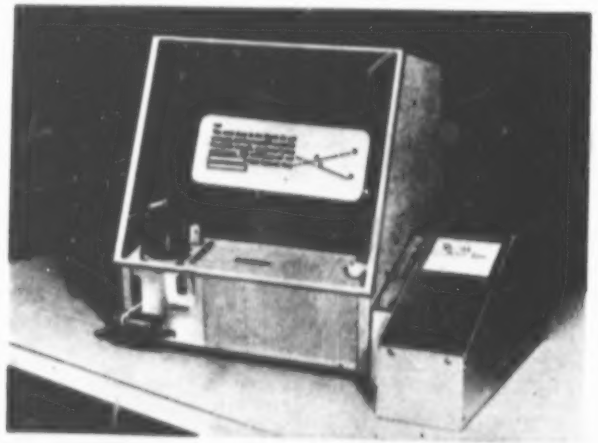
Radio Corp. of America: **AUTOGUIDE**

Magazine loading 35mm slides synchronized with 4-track 3-3/4ips tape cartridge. Recording facility and remote control.

Projected Media: Written Response

Concord Control: FRONT PROJECTION MODEL

Program on 35mm filmstrip and/or 4 X 5 cards. Coupled answer tape; scoring facility; cheat-proof. Folds into case for storage and carrying.

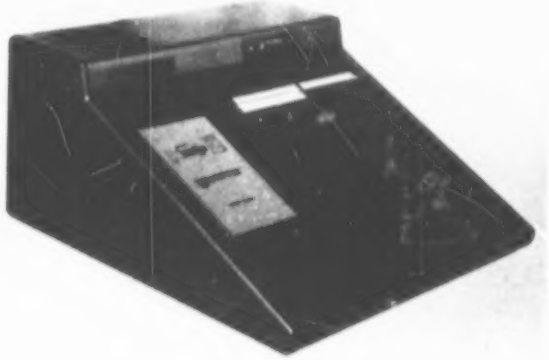


DuKane: REDI-TUTOR

Program on 35mm film half-single-frame or single frame with coupled answer tape. Cheatproof.

Graflex: MICRO-AID

Program on 35mm filmstrip, half-single-frame. Response in special workbook or on answer sheet. Lever uncovers answer area when response is completed.



Hamilton: VISITUTOR - FILMCARD MODEL

Program on 35mm film mounted in aperture cards. Student responds on coupled answer sheet, and if incorrect, writes in correct answer before continuing.

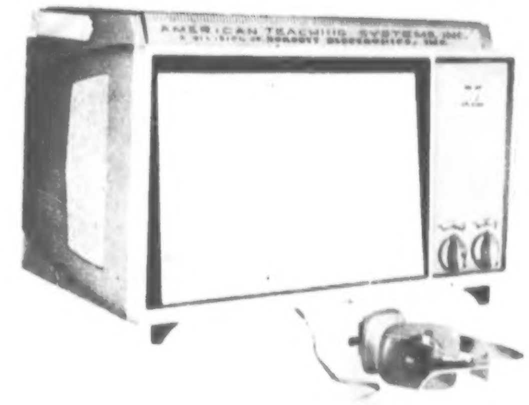
Recordak: MENTOR

Rigid paper envelope 3" X 12" contains 200 frames of 16mm microfilm. Responses are recorded on accessory answer device.

Viewlex: TEACHING MACHINE - RESEARCH MODEL

Program on 35mm filmstrip with separate answer tape. One mechanical action changes question and rotates answer area.

Projected Media: Key Response (1)

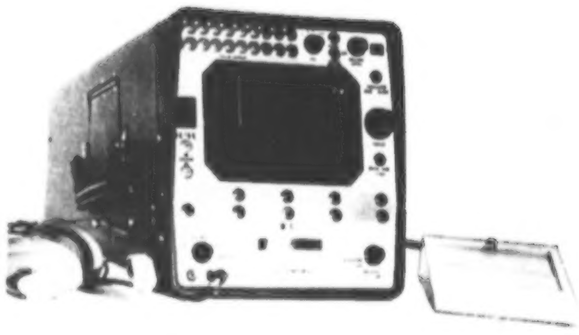


American Teaching Systems: MODEL 834

Program: 35mm double-frame filmstrip and 1-7/8ips 4-track tape in separate cartridges. Response: written on coupled answer scroll; 5-choice key; or oral recording. Student or machine paced; recording capability.

Education Engineering: SPEED

Program on 35mm slides, 3 questions per slide with 10 matching answers. Questions must be answered in order. Incorrect response returns student to stimulus slide for review.

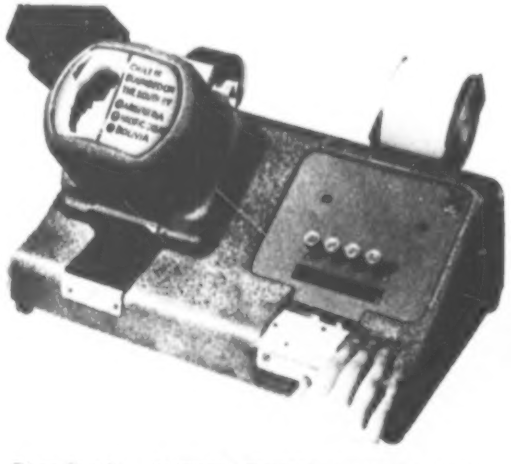


Hughes: VIDEOSONIC--RESEARCH MODEL

Program: 35mm slide magazine with 1-7/8ips tape cartridge, 4-track. Response: written on scroll, machine controlled; 4-multiple-choice; oral completion. Machine or learner paced; 5-channel teleprinter scoring; tape recording facility on machine.

Lectron Corp.: LECTRON MARK I

Program in multi-channel tape cartridge and slide magazine. Three-choice response. Machine folds for storage and carrying.



Standard: VISUAL EDUCATOR MODEL 555

Program on 35mm filmstrip, single-frame. Separate answer tape, 4-choices. Correct response advances program.

Teaching Machines: WYCKOFF FILM TUTOR

Program on 35mm filmstrip, half-single-frame. Typewriter keyboard enables constructed and multiple-choice responses. Correct answer advances program.

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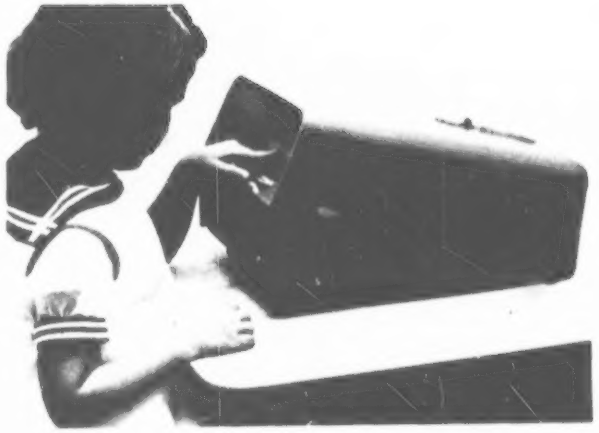
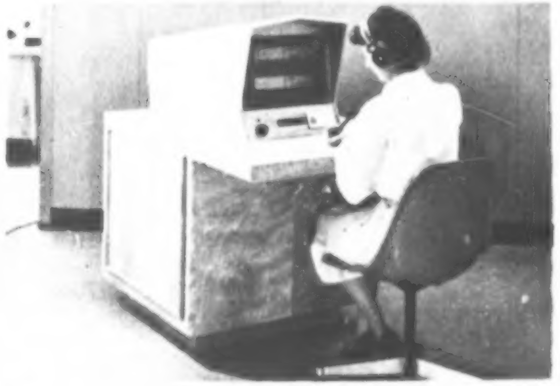
*Not illustrated is the Model 143 teaching machine of the Mast Development Company; Linear device using filmstrip and sound with optional branching.

Projected Media: Key Response (2)



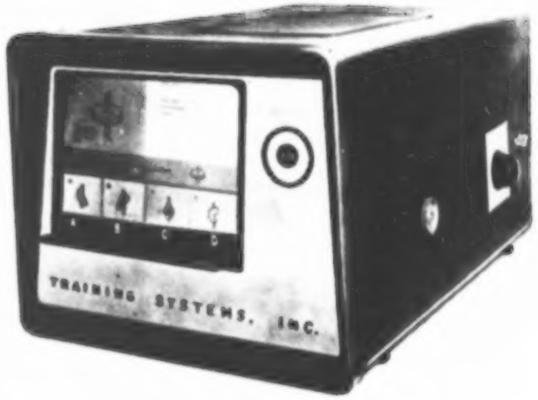
Teaching Machines: MULTIPLE CHOICE

Program on 8mm filmstrip. Student responds by pressing the answer window which corresponds to his choice. Four-choices. Correct answer advances program.



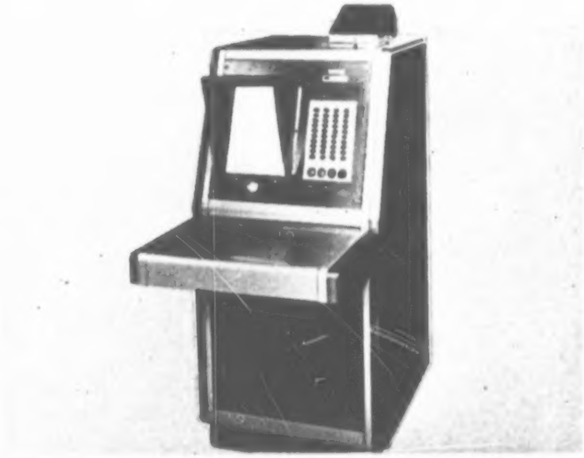
Thompson Ramo Wooldridge: MENTOR

Program on 16mm filmstrip with random access to 16,000 frames; motion picture capability; synchronized 4-track tape. Four-choice response and written answers. Computer weighs and processes response data, and regulates program according to student performance.



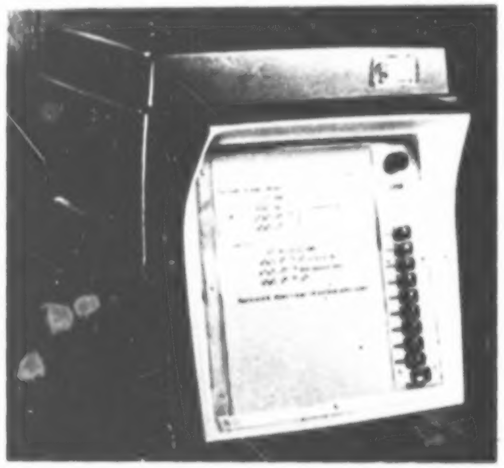
Training Systems: RESEARCH MODEL

Program on 35mm filmstrip, single-frame. Four-choices, branching program. Pressing the chosen response key records response and directs student to answer frame.



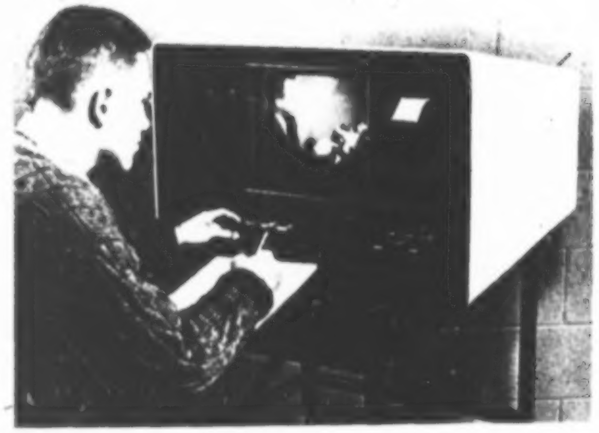
USI Western Design: AUTUTOR MARK I

Program on 35mm film projected as filmstrip or motion picture. Multiple choice; branching facilitated by random access. Response time and sequence recorded on answer tape.



USI Western Design: AUTOTUTOR MARK II

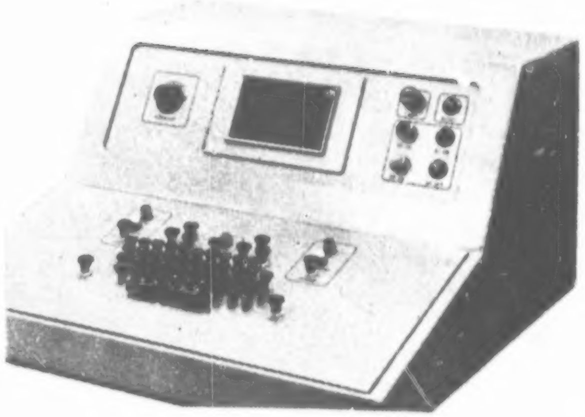
Program on 35mm film projected as filmstrip and motion picture. Multiple-choice with branching. Counter gives total score for each student.



Williams Research: SCIENCE DESK

Sixteen millimeter motion picture with sound. Learner or machine paced. Push button response. Answer recorded on separate answer tape.

Computer Controlled Machines



Aeronutronics: TACHDEN

Digital computer program. Stimulus on cathode ray tube response via typewriter.

Digital: PDP-1 COMPUTER

Program on computer tapes. Stimulus can be presented on cathode ray tube or by typewriter printout; response is via typewriter or light pen.

Marquardt Corporation: MESSAGE COMPOSER

Program on internal format or external digital computer. Stimulus on cathode ray tube, response via typewriter.

Rheem Electronics: KEY PUNCH TRAINER

A psychomotor training device. Typewriter or key-punch operation is taught using a computer which regulates the difficulty of the problems and rate of presentation so that the error rate of the student is maintained at about the 5% level. As the student progresses the speed and difficulty of the program increases; if the student slows down or makes frequent errors, the computer adjusts the program accordingly.

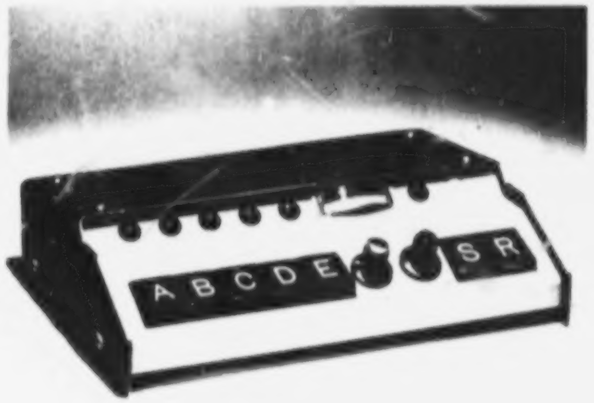
Note: see also the Thompson Ramo Wooldridge MENTOR illustrated in the preceding section. This machine uses a film program which is computer controlled.
Not illustrated is the USI Robodyne DIGIPLEX used for training post-office workers in the use of key operated automatic letter sorting equipment.

Classroom Communication Systems (1)

Classroom communication systems are used in regular instruction by the classroom teacher, and in conjunction with mass media such as films, television, slides, filmstrips, magnetic tape, and (potentially) digital computers.

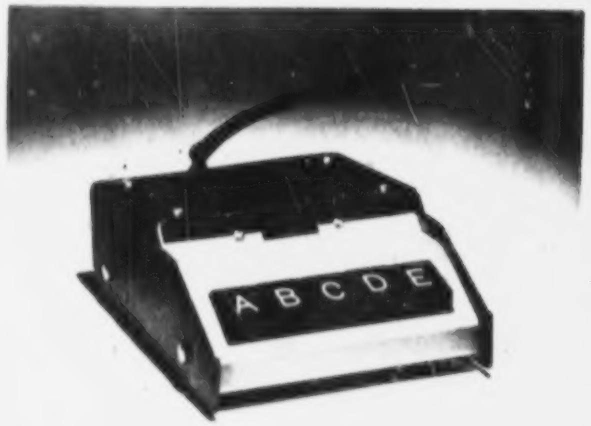
Each student in the group is simultaneously asked to respond to questions from time to time throughout the presentation. Written responses may be recorded on paper rolls which are automatically advanced before the correct answer is given. Multiple choice by pressing keys has advantages in that response data are easily recorded and tabulated, and the student can have immediate knowledge of results by means of red and green indicator lights. Likewise the teacher can have an immediate evaluation of her teaching at any time throughout the lesson by means of error counters or meters which indicate the percentage of correct responses.

The systems approach thus gives the teacher an immediate evaluation of group performance and learning and is a useful research tool for objective measurement of programs and presentations.



Corrigan: TELETEST--TEACHER CONSOLE

Answers cued by classroom teacher or television signal. Light informs teacher of next answer; meter gives percentile rating for class on each question.



Corrigan: TELETEST--STUDENT UNIT

Five choice response. Red and green lights give immediate reinforcement. First response of each student recorded on IBM card for later analysis. Coupled answer tape for written responses under development.

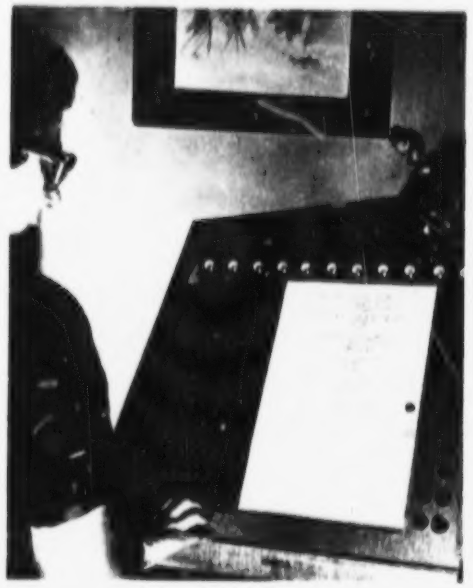
Edex: TEACHING SYSTEM--STUDENT UNIT

Four choice response and automated paper roll. Student performance is scored on individual counters on teacher's console. Scoring can be weighted on a point system or according to response time.

Edex: TEACHING SYSTEM--DISPLAY UNIT

Presentations can be by the classroom teacher, or using film, slides, television, and magnetic tape. Projector unit supplied can be programed by the user; has supervisor recall buzzer and automatic room light operation.

Classroom Communication Systems (2)



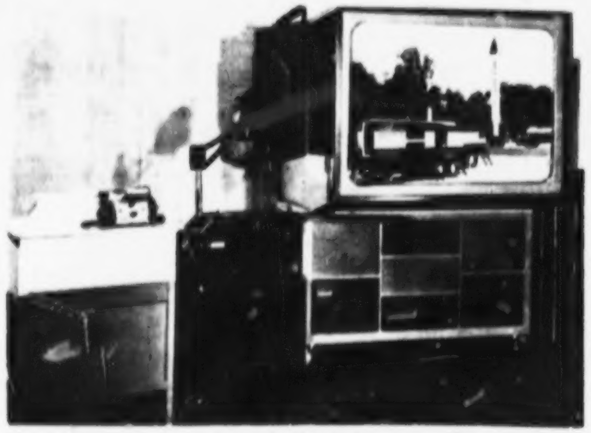
Kunins Engineering: QUIZZO

Teacher's console. Teacher cues correct answers from console; student response is reinforced with indicator lights; machine tallies correct and incorrect answers. Choosing more than one answer per question automatically cancels credit.

Note: A variety of different kinds of system are possible. The Multi-Matics machines illustrated earlier can be electrically joined to allow competition between two students. Dorsett Electronics and the Instrument Research Company are also developing response units for use with group presentation.

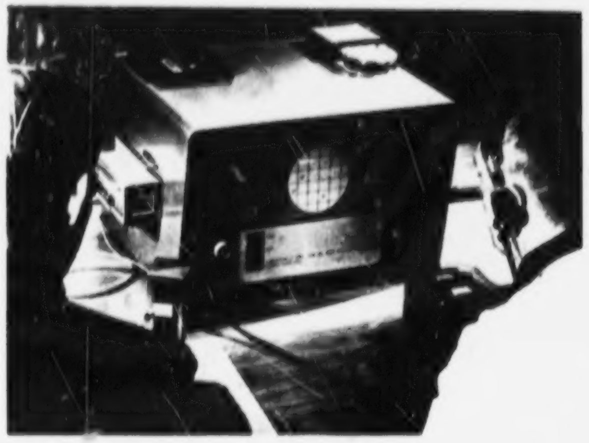
Lectron: MARK V REAR PROJECTION UNIT

Continuous audio-visual presentation can be made using slides and synchronized tape. Multiple choice response buttons are a permanent part of the student desk.



Staples Hoppman: TWO-VU

Student response units (not shown) coupled with presentation system using slides, films, overhead projector, and classroom teacher.



Lectron: AUDIOVISION MARK IV

Response unit for two people used in conjunction with sound-slide presentation.

Teleprompter: MULTIPLE PROJECTION UNIT

Student response units (not shown) coupled with slides, film, and tape pre-programed for multiple screen presentation.

SECTION VI

DIRECTORY OF PROGRAMS

The criteria set up for inclusion in this directory were (a) that the program should be applicable to school or college curricula, and (b) that the program be available for purchase or (c) that the program be under development for the educational market. Possible sources of programs include publishing houses, teaching machine manufacturers, programing companies, research institutes, or schools and colleges preparing programed materials for their own use. These sources do not include industrial programs for in-plant training, military programs, programs developed especially for research purposes, or highly technical programs of very limited application.

For the most part, programed materials are sold in the same way as textbooks, filmstrips, and other instructional materials. However, the programs ordinarily go through a number of testing and revision processes prior to publication, and some of the programs listed as available in the directory are "experimental" in the sense that a further revision will be made. In some instances their use is restricted to schools and colleges willing to share the data resulting from their use..

Counting programs by number is a poor measure of the amount of information which has been programed, as indicated earlier in this report. Number of frames, therefore, has been quoted wherever possible as a guide to the length of each program, but even this can be confusing because some programs use a series of very small steps, requiring numerous items to teach a single concept. Other programs might try to achieve a similar objective in one large step. There are several different theories of programing, but, in addition to the method used, attention must be directed to matching the program to the age, experience, and intelligence level of the group and the kind of teaching problem involved. Again, the educator desiring to use programed learning must be clear in his objectives and willing to experiment.

The presence of any program in this list does not constitute an evaluation or endorsement of any kind by the Staff of the Technological Development Project or any of its sponsors. The list is for information only.

Some programing groups are now supplying research data concerning their programs which include results obtained, group norms, etc. This information should be sought concerning any program. Several national groups in addition to the AERA-APA-DAVI joint committees described in the last section are now working on standards, techniques of evaluation, etc. These include the Educational Testing Service and the Center for Programed Instruction.

Professional educators interested in the applications of programed learning have an obligation to learn as much as possible about the field and its theories and about the programs they intend to use. The reading suggested in earlier sections and contact with such organizations as the Center for Programed Instruction, the Department of Audio-Visual Instruction of the NEA, and the Educational Media Branch of the U. S. Office of Education are recommended as beginning procedures. The use of programed learning materials should not be taken lightly. Programed materials should be selected with at least as much and probably more care than textbooks, films and other materials.

Programs are published in numerous forms. Book formats appear in hard covers and paper-backs, and for use in special loose-leaf folders. Linear programs may be read down the page using some kind of a masking device, or by following a particular strip on the right-hand page through the text. Branching programs are published as "scrambled texts," and the pages are not read in numerical order. Instead the chosen answer will direct the reader to a page which will reinforce his response if correct, or supply remedial problems when he is in error.

There is a lack of standardization of format for machine programs so that in many cases a program can be used only with the machine for which it is designed. Even within each class of machine there may be a lack of standardization. For example, paper rolls come in different width, cards come in different sizes, etc. Projected programs offer a much higher degree of standardization because the ASA film standards have been adopted in most instances. There is still some difference in the way the answer is presented, however.

In coding the company names used in the directory, the format in which the programs are most readily available is listed. This does not mean that a book publishing company would not make a book program available on film or vice versa, but it does indicate that, for the moment at least, where hardware is used the availability of suitable programs must be considered.

Each program is described in terms of the company which supplies it, the program title, and its availability. Programs already available are listed under 1961, programs which will be ready sometime this year appear under 1962. Grade level and number of frames are quoted wherever such information is available. The code for deciphering company names appears on the following page. Grade level may be in numerical form (grades 1 - 12) or in abbreviations such as El. (elementary school), JHS (junior high school), HS (high school), Coll. (college). Number of frames is a numerical quantity. The physical format in which the program appears is listed beside the code.

CODE OF COMPANY NAMES USED IN DIRECTORY OF PROGRAMS		PAPER SHEETS	BOOKS	CARDS	DISCS	ROLL/FAN FOLD	FILMSTRIP	FILM-SLIDES
AIR	American Institute For Research	X	X					
ASTRA	Astra Corporation			X				
ATS	American Teaching Systems						X	X
AVTA	Avta Corporation					X		
BASIC	Basic Systems Inc	X	X					
BILR	Billerett Company					X		
BSF	Basic Skill Films						X	
CPI	Center for Programed Instruction	X	X					
DDAY	Doubleday & Company, Inc.		X					
DEVX	Devereux Teaching Aids	X	X					
DYNA	Dynaslide Company, Inc.	X						
EARL	Earlham College		X					
EBF	Encyclopaedia Britannica Films	X	X					
EDAIDS	Educational Aids Publishing Corp.		X					
EDCARD	Ed-U-Cards Manufacturing Co.			X				
EDENG	Education Engineering Associates							X
EZSORT	E-Z Sort Systems, Ltd.			X				
FIELD	Field Enterprises Educational Corp.				X			
GATRON	General Atronics Corporation		X					
GENED	General Education, Inc.	X	X					
GPTC	General Programed Teaching Corp.	X	X					
HAMIL	Hamilton Research Associates		X	X				
HBW	Harcourt, Brace & World, Inc.		X					
HOLT	Holt, Rinehart & Winston, Inc.		X					
HRBS	HRB-Singer, Inc.	X						
INRAD	Inst. of International Research	X	X					
ITS	International Teaching Systems	X	X					
LEARN	Learning, Inc.	X	X					
MACMIL	The Macmillan Company		X					
MANRES	Management Research Associates	X		X				
McGH	McGraw Hill Book Company		X					
NATM	National Teaching Machines		X					
NYIT	New York Institute of Technology	X	X					
PRA	Psychological Research Associates	X	X					
PROGTA	Programed Teaching Aids, Inc.					X		
RCA	Radio Corporation of America		X					
RENNER	Renner Incorporated	X						
RHEEM	Rheem Califone Corporation					X		
SEMI	Seminar Inc.	X	X					
SIGMA	Sigma Press		X					
SRA	Science Research Associates		X					
TMI	Teaching Machines Inc	X	X				X	
TOR	TOR Education, Inc.	X	X					
TSI	Training Systems, Inc.						X	X
UNIV	Universal Electronics Labs.	X						
VVNN	Van Valkenburgh, Nooger, & Neville	X	X					
WBN	William Barton Marsh Co., Inc.		X					
WEBSTER	Webster Publishing Company		X					
WEST	Western Design & Electronics						X	
WILEY	John Wiley & Sons, Inc.		X					

BUSINESS EDUCATION

	Company	Program Title	Level	#Frames
1961				
	DDAY	Practical Contract Law		
	DYNA	Modern Supervision		
	GATRON	Government Training		
		Insurance Agents		
		Retail Sales Clerks		
	LEARN	Balancing a Bank Account		
	MANRES	Self-Trainer Manager Development		
	SEMI	Trade Competence		
		Essential Computations		
		Sales Judgements		
		Market Strategies		
	TOR	Filing		
	WEST	Everyday Contract Law		
1962				
	AVTA	Introduction to Salesmanship	9th	2000
		Stocks and Bonds		
	ITS	Principles of Accounting (Parts 1 - 5)		1650
	LEARN	Contracts Law		
		Practical Economics		

ELECTRONICS & ENGINEERING

	Company	Program Title	Level	#Frames
1961				
	BSF	How to Read a Resistor		
	DDAY	Introduction to Electronics		430
	INRAD	Trouble Shooting Strategy		
	HAMIL	Black and White Printer Trainer Prog.		
	TOR	Color Code of Electrical Resistors		
	VVNN	Basic Electricity (Vols. 1 - 5)		
		Basic Electronics (Vols. 1 - 6)		
		Basic Synchros and Servomechanisms (Vols. 1 & 2)		
	WEST	First Year Electronics (Vols. 1 - 5)		
		Elementary Electronics		
		Study of the Oscilloscope		
	WBM	Basic Electronics		
1962				
	AVTA	Basic Theory of Transistors	Coll.	1650
		Fundamentals of Electricity: Direct Current	7th	1450
	BASIC	Electricity, Electronics, and Magnetism		
	LEARN	Electrical Safety		
		Trouble Shooting Small Engines		
	McGH	Basic Electricity		
		Basic Electronics		
		Semi-Conductor and Transistor Theory		
		FORTRAN: An Auto-Instructional Program for the Beginner in Computer Programing		
	NYIT	Network Analysis		
	RCA	Basic Electronics (Vols. 1 - 3)		
	TMI	Transistor Theory		
		Vacuum Tubes		

FOREIGN LANGUAGES

	Company	Program Title	Level	#Frames
1961				
	AVTA	Spanish: Basic Reading	9th	3400
	CPI	Beginning Latin		
	EBF	French Phonetics	HS	
		German A	HS	
		Introductory Spanish	HS	
		Spanish A	HS	
	LEARN	Latin Through Stories		
	TMI	Basic German Reading		3643
		Basic Russian Reading		1994
		Basic Spanish Reading		3359
		Modern Hebrew: Basic Reading		1225
	TOR	Intrinsic Spanish: Sounds and Pronunciation		
	UNIV	Spanish	JHS-HS	2200
1962				
	ATS	Elementary French		
		Elementary Spanish		
	AVTA	German: Basic Reading	9th	2000
		Modern Hebrew	9th	1200
		Russian: Basic Reading	9th	2000
	EBF	Conversational Spanish	HS	
		French A	HS	
		Latin		
		Russian		
	GPTC	Elementary French	HS-Coll.	1600
	ITS	Scientific Russian		2000
	TMI	French		
		Italian		
		Latin		
	TOR	Extrinsic Spanish: Vocabulary and Syntax		

HUMANITIES

	Company	Program Title	Level	#Frames
1961				
	DDAY	Logic		
	LEARN	Figures of Speech		
		Basic Materials in Music		
	TMI	Fundamentals of Music		706
1962				
	AVTA	Fundamentals of Music		700
	GPTC	Elementary Music Reading	3 - 4th	1100
		Literary and Poetic Forms	HS-Coll.	
	HBW	Poetry 230		
	LEARN	Art History		
	TOR	Music: Counterpoint and Harmony		

LANGUAGE ARTS

Company	Program Title	Level	#Frames
1961			
AVTA	Punctuation	7th	400
	Spelling	5-6th	3000
CPI	Developmental Reading: Contextual Clues, Part 1		
	Developmental Reading: Phonetic Analysis, Parts 1-6		
	Developmental Reading: Structural Analysis, Parts 1-6		
	Developmental Reading: Comprehension Skills, Parts 1-2		
	Words (Vocabulary Building): Books I, II, III, IV		
EDENG	English I		
	Grammar		
	Spelling		
EZSORT	Basic Sight Vocabulary		
FIELD	100 Spelling Demons		
	Another 100 Spelling Demons		
	About Parts of Speech		
	About the Greek and Roman Gods		
HBW	English Grammar and Usage (English 2600)		2600
ITS	A Programed Course in Modern English Grammar	9-10th	900
LEARN	Grammar: English Fundamentals on Your Own		
	Vocabulary Growth: Divide and Conquer Words		
	Remedial Spelling for Adults		
	Phonetic Approach to Teaching Reading		
SRA	Spelling		
TMI	Spelling	3rd	3000
	Punctuation	7	400
TOR	Copy Editing		
UNIV	English	El	2200
	Spelling	El-JHS	2200

LANGUAGE ARTS (continued)

	Company	Program Title	Level	#Frames
1962				
	ASTRA	400 Spelling Demons		
	BILR	Language Arts		
		Remedial Reading		
		Spelling		
	DDAY	Punctuation		
	EBF	Grammar		
		Spelling		
	EDAIDS	How to Study and Get Higher Marks		
		How to Use a Library		
		Important Principles in English Grammar		
		Spelling Demons		
	EDCARD	Reading Readiness		
		Writing Skills		
	EZSORT	Basic Spelling Words		
		Capitalization and Punctuation		
		English Usage		
	GENED	Penmanship	1st	
		Reading	1st	
		Writing	1st	
	GPTC	Debate Procedure	HS-Coll.	1600
	HBW	English 2600 (revised edition)		2600
		English 3200		
	LEARN	How to Write a Term Paper		
		Study Skills		
	PRA	Language Arts (individual short programs)	4-6th	
	PROGTA	English Grammar		
	TMI	Modern English Usage		
		Vocabulary I		
		Vocabulary II		
		Reading Readiness		
	WEBSTER	Linguistics and Language Usage	6-8th	2500
		Spelling	4-6th	5500

MATHEMATICS

Company	Program Title	Level	#Frames
1961--Algebra and Modern Mathematics			
AVTA	Fundamentals of Algebra (Part I)	9-10th	2000
BILR	Set Theory		
	Symbols and Number Series		
CPI	Exponents and Scientific Notation	JHS	
	Non-metric Geometry	JHS	
	Prime Numbers and Factoring	JHS	
DDAY	Adventures in Algebra		360
EBF	Algebra I	9th	8200
	Algebra II	10th	6750
	The Language of Algebra: Fields and Ordered Fields	Coll.	
EDENG	Algebra I		
	Algebra II		
HAMIL	An Introduction to Permutations		20
HRBS	Introductory Algebra		
INRAD	Signed Numbers		
LEARN	Thinking with Numbers: Basic Concepts		
	Binary Arithmetic		
	Theory of Sets		
NATM	Personal Tutor in Algebra		
SRA	Modern Mathematics	9th	
TMI	Fundamentals of Algebra I	9-10th	1933
	Fundamentals of Algebra II	9-10th	4117
UNIV	Algebra	10-11th	2200
WEST	Introductory Algebra		

MATHEMATICS (continued)

Company	Program Title	Level	#Frames
1962--Algebra & Modern Mathematics			
AVTA	Fundamentals of Algebra (Part II)	11-12th	2000
BASIC	Elementary Set Theory	HS	1000
EBF	Modern Mathematics (A Series)		
EDAIDS	Important Ideas about Algebra		
EZSORT	Algebra		
HOLT	Introduction to Sets	7th	
	Arithmetic of Directed Numbers	7th	
	Equations and In-equations	7th	
MACMIL	Equations (2 booklets)	JHS	
	Number Bases	JHS	
	Number Systems	JHS	
	Modular Number Systems	JHS	
	Sets		
McGH	Sets, Relations, and Functions	HS-Coll.	1035
	Groups and Fields	HS-Coll.	1500
NYIT	First Year College Math	Coll.	
	Second Year College Math	Coll.	
	Third Year College Math	Coll.	
PROGTA	Remedial Algebra		
SRA	Modern Mathematics	10th	
TMI	Modern Mathematics		
WEBSTER	Modern Mathematics: Sets	8-9th	1500
WILEY	Introductory Algebra	Coll.	
	Intermediate Algebra	Coll.	

MATHEMATICS (continued)

Company	Program Title	Level	#Frames
1961--Arithmetic			
AIR	English Money		54
ASTRA	390 Arithmetic Facts (in 8 separate sections)		
	Fractions, Introduction to and Functions of		
	Decimals, Introduction to and Functions of		
AVTA	Fractions	5th	700
BILR	Progression and Number Relationship		
	Regression and Number Relationship		
	Analysing Addition		
	Analysing Subtraction		
	Analysing Multiplication		
	Analysing Division		
DDAY	Fractions: What, Why, and How?		
DEVX	Elementary Arithmetic (35 workbooks)		5200
FIELD	Reviewing Addition Facts		
	Reviewing Subtraction Facts		
	Reviewing Multiplication Facts		
	Reviewing Division Facts		
	Reviewing Fractions		
	Reviewing Decimals		
	Reviewing Percentages		
	About Roman Numerals		
GPTC	Fractions I	5th	2200
	Fractions II	5th	1800
	Ratios, Proportions, and Percentages	7th	2900
TMI	Elementary Arithmetic: Decimal Numbers	4	2665
	Multiplication and Division	3	2076
	Time Telling	1	450
UNIV	Arithmetic	Lower El	2200

MATHEMATICS (continued)

Company	Program Title	Level	#Frames
1962--Arithmetic			
ASTRA	Percentages and Denominate Numbers		
AVTA	Addition and Subtraction	5th	1500
	Decimals	6th	700
	Multiplication and Division	5-6th	2000
BILR	Number Line and the Number System		
EDAIDS	Important Ideas about Numbers and Fractions		
EDUCARD	Math Discovery	1st	
EZSORT	Basic Number Functions		
	Fractions		
GENED	Mathematics	1st	
HBW	Mathematics Enrichment Program for Elementary Grades		
HOLT	Sets	4th	
	Principal Numbers and Factors	4th	
	Common Fractions	4th	
	Number Systems	4th	
LEARN	Numbers Through History		
McGH	Fractions, Decimals, and Percentages	HS	1000
	Finite Arithmetics	HS	1000
	Properties of Numbers	HS	1000
TMI	Elementary Arithmetic: Addition and Subtraction		
	Fractions		
WEBSTER	Arithmetic Topics (a series)	2-8th	6000

MATHEMATICS (continued)

Company	Program Title	Level	#Frames
1961--Computer Mathematics			
DDAY	The Arithmetic of Computers		
RCA	Basic Symbolic Logic		
TMI	Mathematics of Computers		
WEST	Computer Arithmetic		
	Introduction to Computer Mathematics		
1962--Computer Mathematics			
EBF	Mathematical Basis of Management Decision Making		
1961--Calculus			
EBF	Introductory Calculus I	Coll.	
	Introductory Calculus II	Coll.	
1962--Calculus			
DDAY	Calculus (Vols. 1 - 5)		
EBF	Differential Equations	Coll.	
EDENG	Calculus I		
LEARN	Calculus Theory		
TMI	Calculus		
1961-Geometry			
BILR	Geometry		
EBF	Plane Geometry	10th	11,110
EDENG	Geometry I		
HRBS	Plane Geometry		
1962--Geometry			
BASIC	Analytical Geometry		
	Plane Geometry	HS	8400
	Introduction to Logic and Proof		700
EBF	Analytical Geometry	Coll.	
	Solid Geometry	HS	
MACMIL	Informal Geometry I	JHS	
	Informal Geometry II	JHS	

MATHEMATICS (continued)

Company	Program Title	Level	#Frames
1961--Miscellaneous			
DDAY	Math. for Technicians		
	Use of the Slide Rule		
GATRON	Junior High School Mathematics	JHS	
HAMIL	How to Use a Micrometer		160
SIGMA	Basic Mathematics of Science and Engineering		
TOR	Metric System		
	Precision and Significant Figures		
WEBSTER	Modern Mathematics		
WEST	Math Essentials for Science and Electronics		
	Slide Rule Fundamentals (Parts 1 - 3)		
1962--Miscellaneous			
EDENG	General Math		
ITS	Use of the Slide Rule		
LEARN	Slide Rule		
MACMIL	Logical Thinking and Mathematics	JHS	
McGH	Mathematical Logic	HS-Coll.	1000
PROGTA	Elementary Math		
SRA	How We Measure Things with a Ruler		
TOR	Slide Rule		
1961--Statistics			
AVTA	Introductory Statistics	9th	1700
EARL	Elementary Statistics		321
TMI	Introductory Statistics	HS-Coll.	1666

MATHEMATICS (continued)

Company	Program Title	Level	#Frames
1962--Statistics			
BILR	Probability and Statistics		
DDAY	Statistics		
GENED	Statistics: Probability Models of Random Processes		
GPTC	Statistical Supplement	Coll.	1200
LEARN	Elementary Statistics		
MACMIL	What Are the Chances: An Introduction to Probability	JHS	
McGH	Probability	HS-Coll.	975
	Probability and Elementary Statistics	HS	1000
	A Programed Introduction to Statistical Concepts in Psychology and Social Science		
RHEEM	Introductory Statistics	Coll.	
WEBSTER	Modern Mathematics: An Introduction to Probability and Statistics	8-9th	1500
WILEY	Statistics	Coll.	
1961--Trigonometry			
DDAY	Trigonometry: A Practical Course		300
EBF	Trigonometry	HS	4516
WEST	Foundations of Trigonometry		
1962--Trigonometry			
BASIC	Trigonometry	HS	4900
EBF	College Trigonometry	Coll.	
EDENG	Trigonometry I		
HOLT	Introduction to Co-ordinate Geometry	7th	
	Trigonometry at the High School Level	HS	
McGH	Modern Trigonometry	HS-Coll.	2700
PROGTA	High School Trigonometry		

MISCELLANEOUS

	Company	Program Title	Level	#Frames
1961				
	CPI	A Programed Primer on Programing: Vol. I, Basic Principles (2nd ed.)		
		A Programed Primer on Programing: Vol. II, Practical Problems in Writing a Program		
	DDAY	Advanced Bidding		
		The Elements of Bridge		
	EBF	Chess		
	FIELD	About Baseball		
		About Chess		
		About Football		
		Do-It-Yourself		
	ITS	Introduction to International Morse Code (book & mag. tape)		
	LEARN	Fundamentals of Chess		
	WEST	Goren's Bridge for Beginners		
1961--Demonstration and Sample Programs				
	EDENG	The "Speed" Concept of Accelerated Learning		
	FEARON[1]	Explaining Teaching Machines and Programing		
	GPTC	Automobile Insurance Policies		
	LEARN	The U.S. in Space		
	NYSU[2]	Computing the Cost of Wood		16
	TMI	The Principles of Programed Learning		
		Introduction to Word Building		
		Squaring Two-Digit Numbers Ending in Five		

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[1] Fearon Publishing Co., San Francisco

[2] New York State University

MISCELLANEOUS (continued)

	Company	Program Title	Level	#Frames
1962				
	AVTA	Chess		
		Contract Bridge		
	DDAY	Etiquette		
	LEARN	Home Record Keeping		
		Jewish Holidays		
		Interior Design		
		Beginning Bridge: Building Your Bridge		
		Home Repair for Autos		

PSYCHOLOGY

	Company	Program Title	Level	#Frames
1961				
	McGH	The Analysis of Behavior	Coll.	1954
1962				
	HBW	Introduction to Psychology		
	LEARN	Educational Psychology		
	RHEEM	The Analysis of Behavior	Coll.	
	TMI	Principles of Psychology		

SCIENCE

Company	Program Title	Level	#Frames
1961--Biological Sciences			
ASTRA	Human Anatomy and Physiology		
	Introduction to and Functions of Spermatophytes		
LEARN	The Animal Kingdom:		
	I. Vertebrates		
	II. Arthropoda		
1962--Biological Sciences			
BASIC	Cell Physiology and Elements of Biochemistry		
	Mitosis	HS	400
	The Skeletal System	HS	
	The Skin		
EBF	Biology		
HOLT	The Cell		
	Chemistry of Life		
	Genetics		
LEARN	The Protein		
McGH	Introduction to Genetics	HS-Coll.	600
SRA	Discovering a Tiny World Through the Microscope (Text with kit)		
	How Scientists Put Animals into Groups		

SCIENCE (continued)

Company	Program Title	Level	#Frames
1961--General Science			
AVTA	Fundamentals of General Science	9th	2000
FIELD	About Air and Space		
	About Animals		
	About Birds		
	About Coal		
	About Constellations		
	About Dogs		
	About the Earth		
	About Flowers		
	About the Human Body		
	About the Moon		
	About the Sun and Planets		
	About Weather		
GATRON	Elementary Science		
UNIV	General Science	HS	2200
1962--General Science			
EBF	General Science		
EDAIDS	General Science		
TMI	General Science		
1961--Physical Sciences			
CPI	High School Chemistry, Gases I (The Gas Laws)	HS	
	High School Physics, Kinematics, Books I, II, III	HS	
EDENG	Chemistry I		
	Physics I		
GATRON	Review of High School Chemistry		
LEARN	Atomic Theory, Molar Concept, and Problem Solving		
	Chemical and Ionic Equilibrium		
	Solutions		
TMI	Fundamentals of Electricity: Direct Current		1450

SCIENCE (continued)

Company	Program Title	Level	#Frame
1962--Physical Sciences			
BASIC	Atomic Structure	HS	
	Molecules and Reactions	HS	
	Electronegativity, Ionic Bonds, and Valence	HS	
	Covalent Bonds and Structural Formulae	HS	500
	Decomposition, Single Replacement, and Double Replacement	HS	400
	Dispersions and Solutions	HS	800
	Oxidation-Reduction Reactions and Equilibrium	HS	1600
	Acids, Bases, and Hydrolysis	HS	1000
	Physics: Interconversion of Units	HS	1500
	Measurement	HS	1170
	Mechanics	HS	4200
	Thermodynamics	HS	3000
	Electricity and Magnetism (with kit of materials)	HS	3000
EBF	Physics		
	Chemistry		
GPTC	Gas Laws and Measurements	HS-Coll.	1500
HOLT	Classification of Matter	HS	
	Periodic Table	HS	
	Chemical Symbols, Formulas and Equation Writing	HS	
	Molecular and Empirical Formulas	HS	
	Gases	HS	
LEARN	Astronomy: The Solar System		
	Geology: Rock Hounding, Lapidary		
	Introduction to Meteorology		
NYIT	First Year College Physics	Coll.	
SRA	Matter, Its Structure and Forms		
TMI	Elementary Chemistry		
	A.C. Electricity		
WILEY	Fundamental Physics	Coll.	
	Physics	Coll.	

SOCIAL STUDIES

	Company	Program Title	Level	#Frames
1961	DDAY	Parliamentary Procedure		
	FIELD	About Flags		
		About the Presidents		
		About Africa		
		About Asia		
		About Europe		
		About Canada		
		About Latin America		
		About New England		
		About the Middle Atlantic States		
		About the Southern States		
		About the Mid Western States		
		About the Rocky Mountain States		
		About the Southwestern States		
		About the Pacific Coast States		
	LEARN	Basic Tools of Geography		
	UNIV	Geography of the U.S.	El	2200
		History of the U.S.	El	2200
1962	BILR	The American Heritage (10 kits, each 8 programs)		
		Communism		
	EDAIDS	Great Themes in American History		
	EDENG	U.S. History I		
		World History I		
		California History		
	GENED	Mercantilism		
	HOLT	Geography of Africa	HS	
		Geography of China and Japan	HS	
		Geography of Latin America	HS	
		Geography of South East Asia	HS	
	LEARN	Parliamentary Procedure		
		Map Reading		
		Map Reading for Travellers		
	WEBSTER	Social Studies Skills:		
		Latitude	5-6th	400
		Longitude	5-6th	400
		Additional Map Reading	5-6th	150

SECTION VII

DIRECTORY OF MANUFACTURERS AND PUBLISHERS

The following list of suppliers is as accurate as it was possible to make under the conditions of the study described in Section II. It should be emphasized very pointedly that this is not an evaluative list. The information was obtained from the industry. Persons or institutions desiring to investigate programs and teaching machines should contact these suppliers directly and make their own evaluations for their own purposes. Before buying programs, it is suggested that the joint statement of the AERA-APA-DAVI Committee be consulted, and that additional statements of this committee be followed with care.

This list includes some devices other than teaching machines where these names have been used in teaching machine circles. Letter codes or short explanations indicate the nature of the product in each case. The priority of terms is set up as follows: programs, teaching machines, simulated teaching machines, training devices for motor skills, consultants.

CODES

P	programs or programing facility
PP	program publisher
IP	industrial programing group
TM	teaching machine
CM	computer controlled teaching machine
AM	audio-visual type machine without response mechanism
CCS	classroom communication system
SM	simulated teaching machine
MD	masking device
MD-P	masking device integral part of program
PT	pull tab
PB	punchboard
EPB	electronic punchboard
AT	arithmetic trainer
ET	electronics trainer
S	simulator to teach motor skills, usually involving computer
C	consultant in the field of programed learning

SUPPLIERS OF PROGRAMS AND INSTRUCTIONAL DEVICES

A-Alpha Pattern & Manufacturing Co. 2523 E. 4th St., Los Angeles 33, Calif.	TM, SM
Aeronutronic (Div. of Ford Motor Co.) Ford Road, Newport Beach, Calif.	CM, S
American Institute for Research 410 Amberson Ave., Pittsburgh 32, Pa.	P
American Seating Company (See Billerett Company)	
American Systems, Inc. 1625 E. 126th St., Hawthorne, Calif.	AM
American Teaching Systems, Inc. 12902 So. Broadway, Los Angeles 61, Calif.	P, TM
Anirama Company 385 East Green St., Pasadena, Calif.	AM
Applied Communications Systems Div. of Litton Systems, Inc. 8535 Warner Dr., Culver City, Calif. (Programs by Prentice-Hall)	AM
Astra Corporation 31 Church St., New London, Conn.	P, TM
Auerbach Electronics Corporation 1634 Arch St., Philadelphia, Pa.	IP
Automated Instructional Materials Corp. Box 181, Ansonia Station, New York 23, N.Y.	P
Automated Teaching Systems, Inc. 1 West 58th St., New York City, N.Y.	TM
AVTA Corporation 3450 Wilshire Blvd., Los Angeles 5, Calif. (Programs by Institute of International Research and Development, Inc.)	TM
Basic Systems, Inc. 42 East 52nd Street, New York, N.Y. (Published by Lyons and Carnahan)	P
Berkeley Enterprises, Inc. 815 Washington St., Newtonville, Mass.	TM
Billerett Company 1544 Embassy St., Anaheim, Calif. (Programs by Creative Education Resources, Inc.)	TM

Burgess Cellulose Company Grade-O-Mat Division P. O. Box 560, Freeport, Ill.	Test scoring device
Burtek, Inc. 7041 E. 15th St., Tulsa, Okla. (See also Concord Control, Inc.)	S
Central Scientific Company Division of Cenco Instruments 1700 Irving Park Rd., Chicago 13, Ill.	TM
Center For Programed Instruction, Inc. 365 West End Ave., New York 24, N.Y.	P
Chester Electronics Laboratories, Inc. Chester, Conn. (See also Institute For Behavioral Research and Programed Instruction)	Language Lab.
Comparator P. O. Box 452, Petaluma, Calif.	AT
Concord Control, Inc. 1282 Soldiers Field Rd., Boston 35, Mass.	TM
Consolidated Lithographing Corporation Carle Place P. O., Long Island, N. Y.	TM, MD-P
Consolidated Systems Corporation Space Science Department 1500 South Shamrock Ave., Monrovia, Calif.	TM
Corrigan Communications, Inc. 1111 Ash St., Fullerton, Calif.	P, CCS, C
Creative Education Resources, Inc. 1544 Embassy St., Anaheim, Calif. (Programing exclusively for Billerett)	P
Crowell Collier Publishing Company (See the Macmillan Company)	
Cyburtek Corporation 102 Mt. Auburn St., Cambridge, Mass.	P
Davis Scientific Instruments 12137 Cantura St., Studio City, Calif.	Programing device for 2 x 2 slides
Devereux Teaching Aids Box 717, Devon, Pa.	P, TM, AT
DeVry Technical Institute (See Paromel Electronics Corporation)	
Digital Equipment Corporation 146 Main St., Maynard, Mass.	CM

Dorsett Electronics, Inc. 119 W. Boyd, Norman, Okla.	CCS
Doubleday & Company, Inc. 501 Franklin Ave., Garden City, N.Y. (Text versions of USI Western Design Programs)	PP
DuKane Corporation St. Charles, Ill.	TM
Dyna Slide Company 600 So. Michigan Ave., Chicago 5, Ill.	P, MD
Eastman Kodak Company (See Recordak Corporation)	
Edex 809 San Antonio Rd., Palo Alto, Calif.	CCS
Ed-U-Cards Manufacturing Company 13-05 44th Ave., Long Island City, N. Y.	P, TM
Educational Aids Publishing Corp. Carle Place, Long Island, N.Y.	PP
Educational Design of Alabama, Inc. 1428 University Ave., Tuscaloosa, Ala.	P, C
Educational Development Associates 2302 J Street, Eureka, Calif. Programs (For E-Z Sort Systems, Ltd.)	P
Education Engineering Associates 3810 Pacific Coast Hwy, Torrance, Calif.	P, TM
Electronic Teaching Laboratories 5034 Wisconsin Ave., N. W., Washington 16, D. C.	C
Encyclopaedia Britannica Films, Inc. Wilmette, Ill.	P
ERA Research, Inc. 1009 Montana Ave., Santa Monica, Calif.	Science teaching devices
Execugraf Corporation 113 No. San Vicente, Beverly Hills, Calif.	AM
E-Z Sort Systems, Ltd. 45 Second St., San Francisco 5, Calif. (Programs by Educational Development Associates)	SM
Field Enterprises Educational Corporation Merchandise Mart Plaza, Chicago 54, Ill.	P, TM
Foringer and Company, Inc. (See Programmed Teaching Aids)	

General Atronics Corporation One Bala Ave., Bala-Cynwyd, Pa.	P, TM, PT
General Education, Inc. 96 Mount Auburn St., Cambridge 38, Mass.	P, TM
General Programmed Teaching Corporation 1719 Girard N. E., Albuquerque, N. Mex.	P, TM
Ginn and Company Statler Building, Boston 17, Mass.	PP
Grolier Publishing Company (See Teaching Materials Corporation)	
Graflex, Inc. 3750 Monroe Ave., Rochester 3, N.Y.	AM
Gray Manufacturing Company Special Products Division 16 Arbor St., Hartford 1, Conn.	AM
Hamilton Research Associates 4 Genesee St., New Hartford, N.Y.	P, TM
Harcourt, Brace & World, Inc. 750 Third Ave., New York 17, N.Y.	PP
Holt, Rinehart & Winston, Inc. 383 Madison Ave., New York 17, N.Y.	PP
HRB-Singer, Inc. P. O. Box 60, Science Park, State College, Pa.	P, EPB
Hughes Aircraft Company P. O. Box 9094, Airport Station, Los Angeles 45, Calif.	TM
Hunter Manufacturing Company, Inc. P. O. Box 153, Coralville Branch, Iowa City, Iowa	Card display device
Industrial Education Corporation 33 North LaSalle St., Chicago 2, Ill.	IP
The Institute for Behavioral Research and Programed Instruction (IBRPI) P. O. Box 302, Ann Arbor, Michigan	P
Institute of International Research and Development, Inc. (INRAD) P. O. Box 4456, Lubbock, Texas	P
Instructional Systems 497 No. Santa Cruz Ave., Los Gatos, Calif.	IP, C

Instrument Research Company 12031 Euclid Ave., Garden Grove, Calif.	TM, CCS
Institute For Instructional Improvement, Inc. 110 E. 30th St., New York 16, N.Y.	P
International Teaching Systems 457 Washington, S.E., Albuquerque, N. Mex.	P
Jensen, Gerald J. 1267 Wensley Ave., El Centro, Calif.	P, PB
Koncept-O-Graph Corporation 179 Berkeley St., Rochester 7, N.Y.	TM
Kunins Engineering Company 1730 Popham Ave., New York 53, N.Y.	TM
LaBelle Industries Oconomowoc, Wis.	AM
Learning, Inc. 1317 W. Eighth St., Tempe, Ariz.	P
Lectron Corporation of America 9929 W. Silver Springs, Milwaukee, Wis.	TM, CCS
Link Division, General Precision, Inc. Binghampton, N.Y.	ET, S
Litton Industries (See Applied Communication Systems)	
The Macmillan Company 60 Fifth Ave., New York 11, N.Y.	PP
The Marquardt Corporation 2709 No. Garey Ave., Pomona, Calif.	CM, S
William Barton Marsh Co., Inc. 18 East 48th St., New York 36, N.Y.	IP
McGraw Hill Book Company, Inc. 330 W. 42nd St., New York 36, N.Y.	PP
Management Research Associates Room 1300, 185 No. Wabash, Chicago 1, Ill.	PT
Mast Development Company, Inc. 2212 E. 12th St., Davenport, Iowa	TM
Meredith Publishing Company (See Basic Systems)	
Minneapolis-Honeywell Regulator Company 2747 Fourth Ave., South, Minneapolis, Minn.	S
Multi-Matics Machines, Inc. 6782 LaJolla Blvd., LaJolla, Calif.	TM

National Blank Book Company 2829 Water St., Holyoke, Mass.	MD
National Communication Laboratories 507 Fifth Ave., New York 17, N.Y.	P, TM
National Educational Systems, Inc. 9250 Wilshire Blvd., Beverly Hills, Calif.	P, TM
National Teaching Machines Box 4016, El Paso, Texas	P
Nortronics (Div. of Northrop Corporation) 222 N. Prairie Ave., Hawthorne, Calif.	AM
Paromel Electronics Corporation 3956 Belmont Ave., Chicago 18, Ill.	ET
Phoenix Associates Teaching Machines 13012 Willamette St., Westminster, Calif.	C
Picture Recording Company 1392 W. Wisconsin Ave., Oconomowoc, Wis.	AM
Prentice Hall, Inc. Englewood Cliffs, New Jersey (Programs for Applied Communication Systems)	PP
Programmed Learning Associates 700 Font Blvd., San Francisco 27, Calif.	P, C
Programmed Teaching Aids, Inc. 3810 S. Four Mile Run Dr., Arlington 6, Va.	P, TM
The Psychological Corporation 304 E. 45th St., New York 17, N.Y.	P
Psychological Research Associates 507-18th St. South, Arlington, Va.	P
Publishers, Inc. (See U. S. Photo Supply Co., Inc.)	PP
Random House, Inc. 501 Madison Ave., New York 22, N.Y.	PP
RCA Educational Services Radio Corporation of America, Camden 8, N.J.	P, TM, CM, AM
Recordak Corporation 415 Madison Ave., New York 17, N.Y.	P, TM
Renner Incorporated 1530 Lombard St., Philadelphia 46, Pa.	MD, P
Rheem Califone Corporation 5922 Bowcroft St., Los Angeles 16, Calif.	P, TM

Rheem Electronics (Div. of Rheem Manufacturing Company) 5200 W. 104th St., Los Angeles 54, Calif.	CM
Roger Wurtz Company Box 524, San Rafael, Calif.	C
Sanford Associates 159 Crescent Dr., Menlo Park, Calif.	C
Science Research Associates 259 E. Erie St., Chicago 11, Ill.	PP
Scott, Foresman, and Company 433 E. Erie St., Chicago 11, Ill.	PP
Seminar Inc. 480 Lexington Ave., New York 17, N.Y.	IP
Shoentgen, Brandt, and Associates (See Anirama Company)	
Sigma Press 2140 K. St., N.W., Washington 7, D. C.	PP
Singer, L. W. (See Random House)	
Smith Harrison, Inc. (See Devereux Teaching Aids)	
Standard Projector and Equipment Co., Inc. 7433 N. Harlem Avenue, Chicago 48, Ill.	TM
Staples Hoppmann, Inc. 500 E. Monroe Ave., Alexandria, Va.	CCS
Staten, J. B. Box 44, Bay City, Texas	TM
Teaching Machines, Inc. 235 San Pedro, N. E., Albuquerque, N. Mex.	P, TM
Teaching Materials Corporation (Grolier) Sales Organization for Teaching Machines, Inc. 575 Lexington Ave., New York 22, N.Y.	
Teleprompter Corporation 311 W. 43rd St., New York 36, N.Y.	CCS
Thompson Ramo-Wooldridge 8344 Fallbrook Ave., Canoga Park, Calif.	TM
TOR Education, Inc. 55 Fifth Ave., New York 3, N.Y.	P
Training Systems, Inc. 12248 Santa Monica Blvd., Los Angeles 25, Calif.	P, TM

Tucker, Dr. J. A. 504 W. 19th St., Wilmington 2, Del.	C
Universal Electronics Laboratories Corp. 510 Hudson St., Hackensack, N.J.	TM
USI Robodyne (Div. of U. S. Industries) 12345 New Columbia Pike, Silver Springs, Md.	P, TM, S
USI Western Design and Electronics Santa Barbara Airport, Goleta, Calif. (See also Doubleday & Company, Inc.)	P, TM
U. S. Photo Supply Company, Inc. 6478 Sligo Mill Rd., Washington 12, D. C. (Programs by Publishers, Inc.)	P, TM
Van Valkenburgh, Nooger, and Neville, Inc. 15 Maiden Lane, New York 38, N.Y.	MD-P
Viewlex, Inc. Holbrook, Long Island, N.Y.	TM
Webster Publishing Company St. Louis 26, Mo.	PP
John Wiley & Sons, Inc. 440 4th Ave., New York 16, N.Y.	PP
Williams Research Corporation P. O. Box 95, Walled Lake, Mich.	TM
World Book Company (See Field Enterprises Educational Corporation)	

BIBLIOGRAPHY

1. Adams, John. *Exposition and Illustration in Teaching.* New York: The Macmillan Company, 1910.

2. Carpenter, C. R., *et al.* *The Classroom Communicator*, Technical Report SDC 269-7-14. Port Washington, N.Y.: Special Devices Center, October 1950.

3. ______________ *et al.* *The Film Analyzer*, Technical Report SDC 269-7-15. Port Washington, N.Y.: Special Devices Center, October 1950.

4. Chapman, Robert L. *Design Challenges in Employing Programed Learning.* Los Angeles: Thompson-Ramo-Wooldridge, 1961 (offset).

5. Charry, Larry (ed.). *Teaching Machine Program Register.* Philadelphia, Pa.: Temple University Management Services, May, 1961 (mimeo).

6. Dale, Edgar. "The Art of Confusion," *The Newsletter.* Columbus, Ohio: Bureau of Education Research, Ohio State University, December, 1948, pp. 1-4.

7. __________ *Audio-Visual Methods in Teaching*, New York: The Dryden Press (Holt, Rinehart and Winston), 1946.

8. Eigen, Lewis D. *Technology and Educational Practice*, New York: Center for Programed Instruction, 1961 (offset).

9. Foltz, Charles I. *The World of Teaching Machines*, Washington, D. C.: Electronic Teaching Laboratories, 1961.

10. Fry, Edward B. "Programming Trends," *Audio-Visual Instruction*, Washington, D. C.: Department of Audio-Visual Instruction, NEA, April, 1961, pp. 142-143.

11. Fry, Edward, Glenn L. Bryan and Joseph W. Rigney. *Teaching Machines: An Annotated Bibliography*, Supplement 1, *Audio-Visual Communication Review*, Washington, D. C.: Department of Audio-Visual Instruction, NEA, 1960.

12. "Good Morning, Miss Univac," *Bulletin*, Washington, D. C.: Council for Basic Education, October, 1960, pp. 1-2.

13. Hoban, C. F., C. F. Hoban Jr., and Samuel B. Zisman, *Visualizing the Curriculum*, New York: The Cordon Company (Holt, Rinehart and Winston), 1937.

14. Komoski, P. Kenneth. "Programed Instruction - Expandable or Expendable?" *Programed Instruction.* New York, N. Y.: The Center for Programed Instruction, Inc., October, 1961.

15. Leavitt, Jerome E., et al. *Programed Learning and Teaching Machines.* Salem, Oregon: State Department of Education, June, 1961 (mimeo).

16. Lumsdaine, A. A. and Robert Glaser (Eds.). *Teaching Machines and Programed Learning*, Washington, D. C.: Department of Audio-Visual Instruction, NEA, 1960.

17. ______________ "Teaching Machines and Self-Instructional Materials," *Audio-Visual Communication Review*, Summer, 1959, pp. 163-181.

18. ________________ and David J. Klaus. "What's In A Name? A Problem of Terminology," Audio-Visual Communication Review. Washington, D.C.: Department of Audio-Visual Instruction, NEA, July-August, 1961, pp. 208-211.

19. Melton, Arthur W. "The Science of Learning and the Technology of Educational Methods," Harvard Educational Review, Spring, 1959, pp. 96-105.

20. ________________ "Summing Up. Comments Toward the Future," in Finch, Glen (Ed.), Education and Training Media, Washington, D.C.: National Academy of Sciences -- National Research Council, 1960, pp. 196-206.

21. Porter, Douglas. "A Critical Review of a Portion of the Literature on Teaching Devices," Harvard Educational Review, Spring, 1957, pp. 114-132.

22. Rigney, Joseph W. and Edward B. Fry. Current Teaching-Machine Programs and Programming Techniques, Supplement 3, Audio-Visual Communication Review. Washington, D. C.: Department of Audio-Visual Instruction, NEA, 1961.

23. Ross, Wilbur L. Jr. Industry Survey and Buyer's Guide, unpublished mss. in possession of The Center for Programed Instruction, New York City, 1961.

24. "A Schoolman's Guide to Teaching Machines," School Management, Greenwich, Conn., October, 1961, pp. 89-114.

25. Scriven, Michael. "The Compleat Robot: A Prolegomena to Androidology," in Hook, Sidney (Ed.), Dimensions of Mind, New York: New York University Press, 1960, pp. 118-142.

26. Silvern, Leonard. A Systems Approach Utilizing General-Purpose and Special-Purpose Teaching Machines, Los Angeles: Hughes Aircraft, 1961 (offset).

27. ________________ Teaching Machine Technology and Its Relation To Simulation, Los Angeles: Hughes Aircraft, 1961 (offset).

28. Skinner, B. F. "The Science of Learning and the Art of Teaching," Harvard Educational Review, Spring, 1954, pp. 99-113.

29. Stolurow, Lawrence M. Teaching By Machine, Washington, D.C.: U. S. Office of Education, HEW, (Supt. of Documents), 1961.

30. Sturwold, Virginia G. "Sources of Self-Instructional Devices," Audio-Visual Instruction, Washington, D.C.: Department of Audio-Visual Instruction, NEA, April, 1961, pp. 144-145.

31. Tucker, Joseph A. "The Job as a Medium for Training," in Finch, Glen (Ed.), Education and Training Media, Washington, D.C.: National Academy of Sciences -- National Research Council, 1960, pp. 53-68.

APPENDIX A

National Education Association
TECHNOLOGICAL DEVELOPMENT PROJECT

May, 1961.

Survey of Teaching Machines and Related Developments

1. Manufacturer: Name ______________________

Address ______________________

for TECHNICAL information contact ______________________

for SALES information contact ______________________

2. Trade Name and/or Model Number of Device ______________________
(if more than one please use a separate form for each)

3. Stage of Development:

in planning stages only .... ☐ (check one)
a single prototype exists ...... ☐
several demonstration models ☐
in limited production.......... ☐
in full scale production .... ☐

If not yet available, is full scale production planned?

not in present form .... ☐ (check one)
probably yes .... ☐
definitely yes .... ☐

Estimated Date of Availability ______________

Probable Price ____________

If already in production:

List Price ____________ lag in delivery ________ days

Quantity Orders ____________ lag in delivery ________ weeks

4. Type of Device and Program:

program external to device .... ☐ (check one)
program within the device ..... ☐

linear program............... ☐
branching program .... ☐

learner paced .... ☐
machine paced .... ☐

5. Write-in (Skinner Type) Programs:

Is the answer to be written

directly on the program .... ☐ (check one)
on separate answer sheet ..... ☐
other (please specify) ____________________

6. Multiple Choice Type Programs:

number of choices available ____________________

7. Matching Programs:

please specify method of presentation and choice ____________________

8. Scoring and Tabulating Results:

Is the correctness of the students response automatically discriminated by the device?

Yes ☐
No ☐

Is the total score or total error count for each student accumulated automatically?

Yes ☐
No ☐

Is an automatic tally made of the number of students who gave right and wrong responses to each item (frame) of the program?

Yes ☐
No ☐

9. Special Features of Device:

Cheat proof answer system .... ☐
cueing or prompting .... ☐
others (please specify) .... ____________________

____

____

____

____

____

____

10. **Packaging of Program** for ______________________________ machine.

(check all items which apply and supply details)

book	☐	page size ______ X ______	
cards	☐	card size ______ X ______	
paper leaves	☐	page size ______ X ______	
paper fold	☐	width ______ X ______	
paper roll	☐	width ______ X ______	
film slides	☐	film width ______ mm. 1/2-frame ☐	full-frame ☐
film strip	☐	film width ______ mm. 1/2-frame ☐	full-frame ☐
motion picture	☐	film width ______ mm.	
sound on disk	☐	speed ____ r.p.m.	
sound on tape	☐	speed ____ i.p.s.	No. of tracks ______
sound on film	☐	optical ☐	magnetic ☐
television	☐	live ☐	recorded ☐
computer tapes	☐	individual use ☐	group use ☐

other
(please specify) ______________________________

11. **Programs Now Available:**
(list in full)

12. **Programs in Preparation:**

We would greatly appreciate your filling out these forms at your earliest convenience so that we can complete the findings of this survey. Thank you for cooperating on this project.